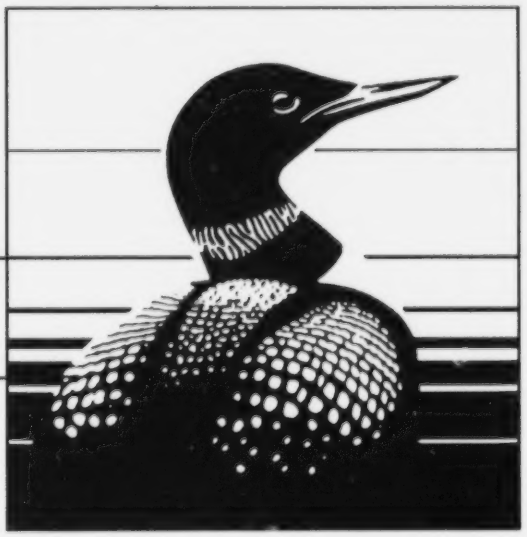
Sensitive Ecosystems Inventory Okanagan Valley: Vernon to Osoyoos 2000 – 2007

Methods, Ecological Descriptions, Results and Conservation Tools

Kristi Iverson, Iverson & MacKenzie Biological Consulting Ltd.
Deborah Curran, Deborah Curran and Company
Tracy Fleming, Fleming Ecological Consultants
Allison Haney, Ophiuchus Consulting

Pacific and Yukon Region 2008
Canadian Wildlife Service
Environmental Stewardship Branch



Technical Report Series Number 495

Environment Canada / Environnement Canada
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B.C. Conservation Data Centre

British Columbia
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2000 – 2007

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Kristi Iverson[1]
Deborah Curran[2]
Tracy Fleming[3]
Allison Haney[4]

Technical Report Series No. 495
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Canadian Wildlife Service

1 Iverson and MacKenzie Biological Consulting Ltd., P. O. Box 511, Lac La Hache, BC V0K 1T0
2 Debra Curran & Company, 49 Pilot Street, Victoria, BC V8V 2A5
3 Fleming Ecological Consulting, 1889 Deborah Drive, Duncan, BC
4 Ophiuchus Consulting, P. O. Box 1572, Oliver, BC V0H 1T0

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Catalogue number: CW69-5/495E
ISBN: 0-662-48081-5

This series may be cited as:
Iverson, K., D. Curran, T. Fleming and A. Haney. 2008. Sensitive Ecosystems Inventory – Okanagan Valley: Vernon to Osoyoos, 2000 – 2007. Methods, Ecological Descriptions, Results and Conservation Tools. Technical Report Series No. 495, Canadian Wildlife Service, Pacific and Yukon Region, British Columbia.

Copies may be obtained from:
Canadian Wildlife Service
Pacific and Yukon Region
5421 Robertson Road, RR1
Delta, B.C. V4K 3N2
Website: http://www.cws-scf.ec.gc.ca/

Acknowledgements

This conservation manual is based on numerous Sensitive Ecosystem Inventories conducted in the Okanagan Valley from 2000 to 2007. We would like to acknowledge the many people who have helped put this and the previous documents together.

This project used the foundation built by those who worked on earlier SEI projects, including the conservation manuals for the East Vancouver Island and Gulf Islands Sensitive Ecosystems Inventory and Central Okanagan Sensitive Ecosystems Inventory. These people include: Carmen Cadrin, Jan Kirkby, Peggy Ward, Gillian Radcliffe and Jeanne Illingworth.

Financial or in-kind support for the projects was provided by: The B.C. Ministry of Environment – Conservation Data Centre, Canadian Wildlife Service, Habitat Conservation Trust Fund, the Real Estate Foundation of BC, the Habitat Stewardship Program, Greater Vernon Services Commission, Allan Brooks Nature Centre, City of Vernon, City of Kelowna, Regional District of the North Okanagan, District of Coldstream, Regional District of the Central Okanagan, District of Lake Country, Weyerhaeuser Canada Ltd and B.C. Conservation Foundation.

Helpful review comments on the report were provided by Jo-Anne Stacey, Kim Everett, Carmen Cadrin, Jan Kirkby, Ted Lea, and Susan Latimer. Jo-Anne Stacey (BC Conservation Data Centre, Ministry of Environment) and Kim Everett (BC Conservation Data Centre) edited the document. Larry Wolfe (Quadra Planning Consultants Ltd.) and Michael McPhee (Quadra Planning Consultants Ltd.) wrote the original version of the conservation tools section; this section was modified to reflect the study area ecosystems. Jenifer Penny provided review of the at-risk plant lists. Wildlife portions of the report were reviewed by Mike Sarell, Rob Cannings, Syd Cannings and Dennis St. John. John Scull and Sheila Harrington (The Land Trust Alliance of BC) provided review of the "What landowners and citizens can do" section. Beacon Hill Communications designed and provided layout for the document.

Susan Latimer, Ted Lea, Kristi Iverson, John Grods, Will MacKenzie, Calvin Tolkcamp, Leah Ramsay, Peter Richardson and Carmen Cadrin provided photographs. Ted Lea provided data from historical ecosystem mapping in the Okanagan Valley.

Abstract

The Okanagan Valley of British Columbia has great ecological significance within Canada. The area has very high biodiversity values, including many at-risk species and ecological communities, and represents ecosystems unique to Canada. The region has been subject to extensive agricultural conversion, intense urban and rural human settlement pressure and significant changes to ecosystem structure and function through the spread of invasive species and fire exclusion. The area's high ecological values combined with the significant pressures on the landscape make the management of the Okanagan Valley of high importance. The study area covers one of the most rapidly growing population centres of British Columbia and development pressures are expected to increase.

The Sensitive Ecosystems Inventory Okanagan Valley: Vernon to Osoyoos is a compilation of numerous individual projects initiated from 2000 – 2007 in response to an urgent need for inventory information on wildlife habitat and sensitive ecosystems to support sound land management decisions. The project area included portions of the lower elevation ecosystems in the Okanagan Valley from just north of Vernon south to the U.S. border. The study area includes part of the Similkameen Valley and some middle and upper elevations in the South Okanagan. This report provides documentation, results, and summary descriptions of the inventories and provides conservation tools for future management.

The main objective of these projects was to provide scientific information on sensitive ecosystems in order to support sustainable land management decisions and encourage conservation and land stewardship. Some projects used Terrestrial Ecosystem Mapping (TEM) as a base to develop a Sensitive Ecosystems theme map and other projects directly mapped Sensitive Ecosystems.

Many of the sites identified by the SEI are at high risk of conversion to other land uses or further degradation. Throughout the study area, 47.9% percent was in Sensitive Ecosystems (SE); 7.9% percent of the area was included in the Other Important Ecosystem (OIE) categories. The inventory results indicated that wetlands, broadleaf woodlands, antelope-brush steppe, sagebrush steppe and old forest ecosystems were extremely rare in the study area covering less than 5% of the project area. Although areas of grasslands, coniferous woodlands and mature forests remained, many had been altered significantly and few high quality sites remain. The study indicates many sensitive ecosystems have already been degraded by fragmentation, human use, livestock grazing and alien species.

Sensitive ecosystems and the wildlife they support are an important part of the quality of life in the Okanagan. With so few rare and fragile ecosystems remaining, it is paramount that each site is treated seriously and all land use options be fully evaluated before any changes are initiated.

Résumé

La Vallée de l'Okanagan en Colombie-Britannique est un endroit qui revêt une grande importance écologique pour le Canada. On trouve à cet endroit une très grande biodiversité, y compris un grand nombre d'espèces et de collectivités à risque de même que des écosystèmes uniques au Canada. La région a subi une vaste conversion agricole, d'intenses pressions de peuplement urbain et rural et d'importants changements à la structure et à la fonction de l'écosystème par la propagation d'espèces envahissantes et l'aménagement de zones de protection contre les incendies. En raison de la grande valeur écologique de cette région et des pressions intenses qu'a subi le paysage, la gestion de la Vallée de l'Okanagan prend une très grande importance. La zone à l'étude englobe un centre de population dont les taux de croissance est l'un des plus rapide en Colombie-Britannique et on s'attend à ce que les pressions qui poussent au développement augmentent sensiblement.

L'inventaire des écosystèmes sensibles de la Vallée de l'Okanagan effectué de Vernon à Osoyoos regroupe bon nombre de projets lancés entre 2000 et 2007, en réponse au besoin urgent de recueillir des renseignements au sujet de l'habitat faunique et des écosystèmes sensibles pour appuyer la prise de saines décisions de gestion des terres. La zone visée par le projet englobe certaines parties de l'écosystème des terres basses de la Vallée de l'Okanagan qui se trouvent immédiatement au nord de Vernon et s'étendent vers le sud jusqu'à la frontière des États-Unis. Cette zone englobe une partie de la Vallée de Similkameen et certaines des terres moyennes et hautes qui se trouvent à Okanagan Sud. Dans le présent rapport, on trouvera des documents, des résultats et des descriptions sommaires des inventaires de même que des outils de conservation qui serviront plus tard à la gestion.

Le principal objectif de ces projets était de recueillir des renseignements scientifiques au sujet des écosystèmes sensibles afin d'appuyer des décisions de gestion durable des terres et en favoriser la conservation et l'intendance. Pour certains projets on a fait appel à la Cartographie des écosystèmes terrestres afin d'établir une carte thématique des écosystèmes sensibles et d'autres projets de cartographie directe des écosystèmes sensibles.

Bon nombre des sites relevés dans l'inventaire des écosystèmes sensibles font face à un risque sérieux de conversion à d'autres utilisations des terres ou de dégradation accrue. Partout dans la zone à l'étude, 47.9% de la superficie se trouvait dans des écosystèmes sensibles, 7.9% de cette zone était classé dans les catégories d'autres écosystèmes importants. Les résultats des inventaires ont permis de conclure que les milieux humides, les régions boisées de feuillus, les steppes de purshie tridentée, les steppes d'armoise et les écosystèmes de vieilles forêts étaient extrêmement rares dans la zone à l'étude et occupaient moins de 5% de la zone visée par le projet. Bien qu'il restait des zones de

prairies, de boisés de conifères et de peuplements murs, bon nombre avaient subi d'importantes altérations et il restait très peu de sites de haute qualité. L'étude indique également que de nombreux écosystèmes sensibles ont déjà été dégradés par la fragmentation, l'utilisation par les humains, le pâturage du bétail et les espèces étrangères.

Les écosystèmes sensibles et la faune qu'ils accueillent contribuent largement à la qualité de la vie dans la Vallée de l'Okanagan. Comme il reste très peu de ces écosystèmes rares et fragiles, il est primordial que chaque site soit pris au sérieux et que toutes les options d'utilisation des terres soient pleinement évaluées avant que l'on procède à quelque changement que ce soit.

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Using This Report

This report presents information on sensitive ***ecosystems***[1] in the Okanagan Valley, and provides guidance regarding conservation and management. The report is intended for people and organizations that need information to help conserve and protect sensitive and important ecosystems in the Okanagan Valley and other similar areas. The Okanagan SEI is also intended to provide information and advice to landowners, developers, local and provincial government and the public on how to minimize and avoid possible degradation of remaining sensitive ecosystems.

This report is divided into two sections. *Section One* describes and discusses the importance of Sensitive Ecosystems Inventory (SEI) ecosystems, describes impacts of concern, and recommends how to avoid these impacts. *Section Two* presents conservation tools that are available to individuals and different levels of government, and describes how various legal tools can be used to implement management recommendations.

Section One

Chapter 1: Introduction sets the context of the SEI project by describing the importance of biodiversity and the study area. *Chapter 2: Ecosystems of concern* outlines the importance of sensitive ecosystems and the need for concern. *Chapter 3: Impacts of concern* describes the types of impacts that are of concern. *Chapter 4: Methods and limitations* explains how the mapping was completed and limitations of the mapping. *Chapter 5: Inventory results* describes the current overall status of sensitive ecosystems in the study area.

Chapters 6 through *17* profile each of the ten sensitive ecosystems and two other important ecosystems. Each chapter provides a detailed description of the specific ecosystem, its status and importance in the study area. Impacts and management recommendations are also discussed.

Chapter 18: Planning and management outlines the general steps involved in conservation planning and describes basic management concepts that are applicable to all Sensitive and Other Important Ecosystems. *Chapter 19: Future directions* contains recommendations for updating the SEI products, and completing the inventory's coverage.

Section Two

This section provides guidance on legal tools that are available to promote conservation and effective management of sensitive ecosystems. Each chapter in this section deals with a different level of management and planning.

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1 The first occurrence of terms found in the Glossary is highlighted in ***bold italics.***

Chapter 20: What local governments can do discusses many of the legal conservation tools available to local and regional governments. Official Community Plans, Development Permits, and a number of other land use bylaws are discussed with regards to incorporating the management recommendations.

Chapter 21: What landowners and other citizens can do outlines what landowners and members of the public can do to encourage and facilitate conservation through tools such as ***conservation covenants***.

Chapter 22: What senior governments can do discusses key federal and provincial legislation that can help conserve sensitive ecosystems.

Section I
Descriptions and Management Recommendations

1 Introduction

The Ministry of Environment, Canadian Wildlife Service, Regional Governments of the Okanagan Valley and conservation organizations, initiated this project as a means to identify the remaining sensitive ecosystems in the Okanagan Valley. This report describes sensitive and other important ecosystems in the Okanagan and provides an overview of inventory methods, results, and conservation tools for maintaining the ecological integrity of the area.

This report follows the format of the East Vancouver Island and Gulf Islands SEI[2] and the Central Okanagan SEI[3] conservation manuals. Many of the materials in this report have been adapted from these reports.

The Okanagan Valley SEI is intended to be a working document that can be used to mitigate damaging effects of past activities, and to encourage local governments, landowners, developers, and other citizens to become involved in protecting, conserving, and restoring ***sensitive ecosystems***. Conservation of these ecosystems becomes especially important as rapid population growth in the Okanagan continues to cause the loss or degradation of many sensitive ecosystems (see sidebar).

Sensitive ecosystems are ecologically fragile or at-risk portions of the landscape with relatively uniform vegetation and soils. Sensitive ecosystems are critical areas of high conservation value; however they are not the only areas worth preserving. Sensitive ecosystems must be considered in the context of the overall landscape, which includes other ecosystems that are important to a wide variety of flora and fauna. Connectivity with other sensitive ecosystems and natural areas should be preserved to allow migration and dispersal of ***wildlife***.

Population Statistics
The population for the Regional District of the Okanagan-Similkameen was estimated at 81,278 in 2004 and is projected to grow to 105,328 by 2031. The population estimate for the Regional District of the Central Okanagan was estimated at 165,224 in 2005 and is projected to grow to 244,333 by 2031. The North Okanagan Regional District had an estimated population of 79,097 in 2004 and projected population of 109,038 in 2031. This population growth will place continuing pressure on the remaining sensitive ecosystems in the Okanagan.

Sensitive Ecosystems Inventory (SEI)

The Okanagan Valley is an area of tremendous biological and ecological significance, but also has the highest population density in the British Columbia interior and covers one of the most rapidly growing population centers in the province. The Okanagan Valley has been significantly altered by human use, and many sensitive ecosystems and wildlife habitats have been lost or degraded. Land managers and private landowners need to protect biodiversity to manage for sustainable communities, and populations need to be aligned with the carrying capacity of the region.

The purpose of these SEI projects was to develop an inventory information base to support sound land management decisions, and promote conservation

2 Ward et al. 1998
3 Iverson and Cadrin 2003

and effective stewardship of remnant rare and fragile ecosystems and the species that rely on them. The goal was to provide all levels of government with the necessary data and information for a variety of resource management issues, and to provide the Okanagan — Similkameen Regional District, Central Okanagan Regional District, District of the North Okanagan and their member municipalities with data that could be used in developing Regional Growth Strategies, Official Community Plans, Local Area Plans, and Greenspaces and Parks Plans.

The SEI can be used as a flagging tool to indicate areas that need more evaluation during local planning processes.

This product is intended to provide information in a user-friendly format that can be accessed by the general public, landowners, developers, professional biologists, planning staff, non-government organizations, and others. SEI ecosystems can be flagged as sites requiring more detailed evaluation during local planning processes. Additionally, the SEI can be used in assessing individual development proposals and can provide land developers, public interest groups, and the general public with scientific information needed to support conservation efforts.

The SEI can be used by the provincial Ministry of Environment to review environmental impact assessments, assess impacts of land developments on at-risk species and at-risk ecological communities, identify conservation priorities and options, identify important sites for inventory, and determine the availability and ownership of important habitats. The B.C. Conservation Data Centre uses SEI information to assess conservation status of at-risk ecological communities.

The federal government uses SEI in the Canadian Environmental Assessment Act (CEAA) process to identify areas of concern that must be addressed. In addition, SEI can provide background information for site specific land uses, agency research projects and conservation strategies.

Many government agencies and non-government organizations hope to extend coverage of sensitive ecosystems mapping to all low- and mid-elevations of the Okanagan Valley.

The ***Habitat Conservation and Stewardship Program*** provides detailed analysis of the condition of aquatic habitats in some portions of the study area. The Habitat Conservation and Stewardship Program completed a Sensitive Habitat Inventory Mapping (SHIM) project in the Regional District of the Central Okanagan and the City of Kelowna. The SHIM provides information on fish and aquatic habitats and detailed larger scale mapping of stream riparian ecosystems than is provided by this SEI.

Study Area

The study area (Figure 1) is located in south-central British Columbia. The area covers 369,431 ha, and includes private and publicly-owned lands within 11 ***biogeoclimatic subzones*** and variants ranging from the Okanagan Very Dry Hot Bunchgrass Variant (BGxh1) at the lowest elevations to Engelmann Spruce – Subalpine fir (ESSF) variants at the highest elevations.

The study area is located within the Southern Interior ***Ecoprovince***[4], the northern extension of the Columbia Basin that extends south to Oregon

4 The ecoregional classification system was developed and adapted by the Ministry of Environment, Wildlife Branch, to provide a systematic view of the small scale ecological relationships within British Columbia. See Demarchi 1996 for further information.

and lies within the following ***Ecosections***: Southern Okanogan Basin (SOB) Ecosection, the southernmost portion of a wide trench carved out by the movement of a huge glacier; the Southern Okanogan Highland (SOH) Ecosection, a transitional mountain area above and east of the SOB; the Shuswap Basin (SHB) Ecosection, a highland area intermediate between the plateaus to the west and the mountains to the east; the Okanagan Range (OKR) Ecosection, an area of high mountains and dry valleys west of the SOB; the North Okanagan Basin (NOB) Ecosection, the northern extension of the Okanagan Valley covering the Central and North Okanagan Valley; and the North Okanagan Highland (NOH) Ecosection, a cool, moist transitional plateau above and east of the NOB.

The BC Ministry of Forests Biogeoclimatic Ecosystem Classification (BEC) is a system of classifying vegetation based on climatic and topographic patterns.[5] Eleven biogeoclimatic subzones or variants are represented within the study area; the Okanagan Very Dry Hot Bunchgrass Variant (BGxh1), Okanagan Dry Cold Engelmann Spruce – Subalpine Fir Variant (ESSFdc1), Okanagan Dry Cold Engelmann Spruce – Subalpine Fir Parkland Variant (ESSFdcp1), Okanagan Dry Cold Engelmann Spruce – Subalpine Fir Unnamed Variant (ESSFdcu1), Very Dry Cold Engelmann Spruce – Subalpine Fir Subzone (ESSFxc), Okanagan Dry Cool Interior Douglas-fir Variant (IDFdk1), Okanagan Dry Mild Interior Douglas-fir Variant (IDFdm1), Okanagan Very Dry Hot Interior Douglas-fir Variant (IDFxh1), Okanagan Dry Mild Montane Spruce Variant (MSdm1), Very Dry Cool Montane Spruce Subzone (MSxk), and the Okanagan Very Dry Hot Ponderosa Pine Variant (PPxh1).

The study area includes the following project areas:

- Bella Vista – Goose Lake Range SEI
- Central Okanagan SEI
- City of Kelowna SEI
- Coldstream – Vernon SEI
- District of Lake Country SEI
- Joe Rich SEI
- Naramata SEI
- South Okanagan SEI
- TFL 15 Terrestrial Ecosystem Mapping
- Vernon Commonage SEI

As of 2007, gaps in coverage of the low elevations in the Okanagan Valley include the District of Peachland, small gaps for Indian Reserves Tsinstikeptum I.R. 9 and 10 along the west side of Okanagan Lake, and some small gaps in the South Okanagan (e.g. private land in TFL 15).

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5 The Biogeoclimatic Ecosystem Classification system was developed by the Ministry of Forests to provide a basis for natural resource management, particularly forest and range management. See sidebar and Pojar *et al.* 1987 for further information.

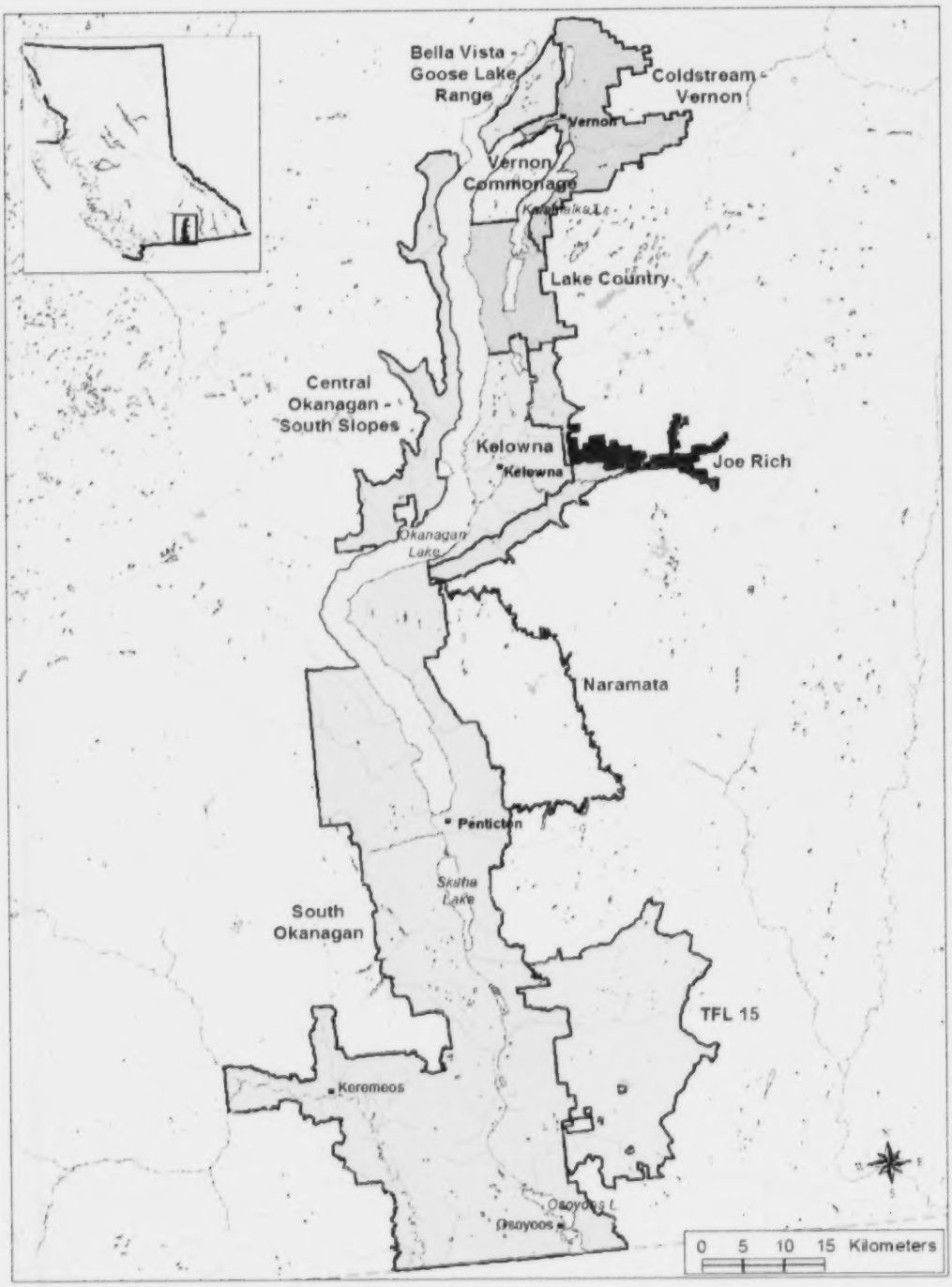

Figure 1. Study area map

Figure 2. Ecosystems of the Okanagan Valley. a) Displays some of the pressures on sensitive ecosystems; b) a typical Shrub-steppe ecosystem that is of high conservation value in the study area (Photo credits: Carmen Cadrin)

Nearly all of the lands within the hot, dry, low- and mid-elevations of the valley are included in the study area. These areas are considered to be more biologically diverse and under greater pressure from urban settlement than the upper elevation lands and include concentrations of at-risk ***ecological communities*** and species at-risk (Figure 2). These low- and mid-elevation lands form a critical portion of the Okanagan corridor which is needed to maintain ecological connectivity across the landscape.

A high proportion of land within the study area is privately owned, with 36.8% of the land base falling within private land, and 41.7% falling within public land (Table 1). Protected lands cover 8.6% of the study area in the form of provincial or regional parks.

Table 1. Percentage of land in the study area that was crown, private or protected.

Land Status	Percent of Study Area
Crown Land	41.7%
Private Land	36.8%
Indian Reserves	12.9%
Parks and Protected Areas	8.6%

Ecological Importance of the Study Area

The Okanagan Valley is a region of nearly unparalleled ***biodiversity*** within British Columbia and the rest of Canada. The area is characterized by a complex landscape of rugged, steep, and rocky terrain, plus gently sloping ***terraces.*** These formations result from glacial lakes and the movement of materials by melting ice during the retreat of the last glaciers 10-15,000 years ago. Since that time, **erosion** and ***deposition*** by wind and streams has further shaped the landscape, and the movement of material by gravity has formed ***cones***, slide deposits, and ***talus*** slopes. There are several glacial-relic lakes in the bottom of the valley, including Osoyoos, Vaseux, Okanagan, Kalamalka and Skaha Lakes.

The Okanagan Valley experiences some of the warmest and driest weather conditions in the province. A rain shadow caused by the Coast and Cascade Mountains reduces precipitation in both winter and summer. In summer, hot dry air moves in from the Columbia Basin to the south and very hot temperatures are common. The presence of Osoyoos, Vaseux, Okanagan, and Kalamalka Lakes, moderates these temperatures somewhat by cooling the air in summer and warming it in winter.

The complex terrain of the area, combined with a moderated semi-arid climate has resulted in a wide diversity of ecosystems and organisms. Ecosystems range from open ponderosa pine forests, to grasslands, to cliffs and talus slopes, to a wide diversity of ***riparian*** and wetland ecosystems, often within close proximity of one another.

The Okanagan Valley contains many of the province's at-risk ecological communities. Many of these are limited in distribution to the Okanagan Valley and other hot, dry valleys in the southern interior. More than half of the ecological communities in the study area are on either ***red-*** or ***blue-listed*** by the B.C. Conservation Data Centre or have not yet been ranked.

The large variety of ecosystems provides for diverse habitat needs of wildlife and plant species. A high proportion of these species are considered at-risk both provincially and federally (Appendix II and III), due to very restricted ranges and their reliance on sensitive ecosystems.

North American Context

In many places, human definitions of rarity are artificially influenced by political boundaries. Although initially it may seem that the species, ecosystems, and biodiversity of the Okanagan Valley are well represented south of the Canada-U.S. border, many conditions make the Okanagan Valley a unique place that is of vital importance to the continent and the rest of the world.

The Okanagan Valley is a north to south corridor that connects the dry interior landscapes of the Nicola, Thompson, Fraser, Salmon and Chilcotin Rivers in British Columbia to southern grassland and shrub-steppe ecosystems of the Columbia Basin in the U.S., which, in turn, connect to the deserts of the south-west U.S. and Mexico. This corridor has been the principal entry route for southern plants and animals into B.C.'s dry interior. This corridor forms the main

spring and fall migration route for many species of birds, and will likely play a critical role in their migration during climate change.

The diversity of habitat types in relatively close proximity to one another, combined with the moderating influence of relic glacial lakes on the local climate, distinguishes the Okanagan Valley from the vast Columbia Basin to the south.

The pressures from agricultural conversion and urban development that have resulted in habitat loss and threats to many species are not unique to the Okanagan Valley. Although urban development pressures are not as apparent south of the Canada-U.S. border, impacts from agriculture conversion, invasive ***alien plants***, ***fire exclusion***, channelization of streams and rivers, and alteration and infilling of wetlands have caused declines in many species and ecological communities that were formerly common. For example, in many areas of Canada and the U.S., only 0.1% of grasslands remain in a natural state[6].

Increasingly, scientists are finding that peripheral populations have a genetic resilience that allows them to persist in more adverse conditions, which may allow them to adapt to future changes such as global warming better than core populations[7]. Many of the species that occur in the Okanagan comprise peripheral and often disjunct populations, since they are at the northern end of their range and therefore are of significant ecological value.

6 Henwood 1998
7 Scudder 1991

2 Ecosystems of Concern

Why the Concern?[8]

Most people realize that they depend on natural resources for food, medicine, and the raw materials from which industrial products such as fibres for clothing or lumber pulp for paper are manufactured. Additionally, plants, animals, and the natural landscape provide aesthetic and recreational enjoyment through activities such as gardening, bird watching, and eco-tourism. All these factors serve to bolster the economy.

Recently, a team of ecologists and economists conservatively estimated that the annual value of the world's ecosystems, taking into account all the services they provide, was at least $33 trillion (U.S.) compared to a world annual gross national product (GNP) of around $18 trillion (U.S.)[9].

Ecosystems, however, are not fully considered in the marketplace, nor are they valued along with our economic services and manufactured capital. In the past, if they were considered at all, they were given too little weight in policy decisions.

There is more to biodiversity, however, than simply economics. Ecosystem processes provide services that regulate the climate, clean freshwater, sustain soils, maintain genetic diversity, recycle nutrients, and pollinate crops. Simply put, ecosystems provide the materials and processes that allow humans to live here on earth.

Current and future climate change will impact forests, wetlands, rivers, and coastal areas, as well as the human communities that depend upon them. As climate changes threaten ecosystems and ecosystem services, intact natural ecosystems will be the most resilient and provide the best opportunities for adaptation by providing corridors for migrating wildlife, water storage, and flood protection. Natural ecosystems provide carbon dioxide absorption and carbon storage capabilities. Intact natural systems store the most carbon.[10]

It is easy to understand why much of the Okanagan has been reduced to small remnants of former ecosystems that once defined the region. People are often attracted to the most beautiful and hospitable places to live, but the impact of their presence and activities can cause degradation or loss of the integrity and beauty of these areas for both present and future generations.

8 Adapted from McPhee *et al.* 2000
9 Costanza *et al.* 1997
10 Wilson and Hebda 2008

Table 2. Sensitive Ecosystem classes and subclasses

Code	Sensitive Ecosystems	Ecosystem Description
WN	Wetlands	Non-forested ecosystems where the water table is at or near the surface; includes **marshes** (WN:ms), **swamps** (WN:sp), **wet meadows** (WN:wm or WN:md), **fens** (WN:fn), and **shallow open water** (WN:sw) ecosystems
RI	Riparian	Streamside and lakeside ecosystems or sites with significant seepage; includes ecosystems on floodplains and benches along creeks and rivers (**bench**, RI:fp), shrub dominated floodplains and lakeshores (**shrub**, RI:sh), ecosystems in gullies, often with creeks (**gully**, RI:gu); fringe ecosystems associated with pond and lake shorelines or sites with significant seepage (**fringe**, RI:ff), the river bed of large systems (**river**, RI:ri), and beaches on lakes (**beach**, RI:be)
OF	Old Forest	Forest ecosystems dominated by large, old ***coniferous*** trees (OF:co); excludes old riparian forests
AS	Antelope-brush Steppe	Ecosystem dominated by antelope-brush and ***bunchgrasses*** (AS:as) and **disturbed** antelope-brush steppe dominated by antelope-brush and invasive alien plants (AS:ds)
GR	Grasslands and Disturbed Grasslands	Gently sloping ecosystems dominated by bunchgrasses (**grassland**; GR:gr), **steep slope** grasslands (GR:st), **steep, shallow soil** grasslands (GR:ss), and **disturbed** grasslands dominated by invasive alien plants (GR:dg or DG:dg)
SS	Sagebrush Steppe	Gently sloping ecosystems dominated by big sagebrush and bunchgrasses (SS:ss), **steep slope** sagebrush steppe (SS:st), **steep, shallow** soil sagebrush steppe (SS:sh), and **disturbed** sagebrush steppe dominated by big sagebrush and invasive alien plants (SS:ds)
BW	Broadleaf Woodlands	Ecosystems dominated by ***deciduous*** species including **aspen copses** (BW:ac); excludes old forests and riparian
WD	Coniferous Woodlands	Open stands of Douglas-fir or ponderosa pine; excludes old forests
SV	Sparsely Vegetated	Ecosystems where rock and talus prevent vegetation development; includes shrubby rock outcrops (**shrub**; SV:sh), sparsely vegetated or unvegetated **rock outcrops** (SV:ro), **talus** (SV:ta), and **cliffs** (SV:cl)
AP	Alpine	High-elevation alpine and parkland ecosystems including **herbaceous** ecosystems dominated by forbs or graminoid vegetation (AP:hp), **parkland forests** where trees occur in distinct clumps (AP:pf), and **shrub** ecosystems dominated by dwarf shrubs such as heather (AP:sh)

What are Sensitive Ecosystems?

This sensitive ecosystems project recognizes both *sensitive ecosystems* and *other important ecosystems* in the study area[11]. *Sensitive ecosystems* refer to ten ecosystem types (Table 2) that are relatively unmodified, and are ecologically fragile, or are recognized as being at-risk in the provincial landscape[13]. The *other important ecosystems* are partially modified ecosystems that provide many natural values including wildlife habitat, wildlife corridors, buffers between developed areas and sensitive ecosystems, and sources of potential recruitment for some sensitive ecosystems (Table 3).

Sensitive ecosystem categories have been developed to reflect local ecosystems and to be as consistent as possible with the previous and ongoing Sensitive Ecosystems Inventory projects[14]. Categories of sensitive ecosystems represent generalized groupings of ecosystems that share many characteristics, particularly ecological sensitivities, ***ecological processes***, rarity, and wildlife habitat values. Within developed landscapes, sensitive ecosystems provide ***patches*** of natural areas that have intrinsic values, and are critical to the survival of many species. These ecosystems are vital in creating healthy and attractive communities for people.

For the SEI, an ecosystem is defined as a portion of the landscape with relatively uniform vegetation and soils[12]. A sensitive ecosystem is one which is at-risk or ecologically fragile.

Why are these Ecosystems Important?[15]

The ecological and socio-economic values that are common to all SEI ecosystems are discussed below. Values and attributes unique to individual ecosystems are discussed in Chapters 6 to 17.

Table 3. Other Important Ecosystem classes and subclasses

Code	Other Important Ecosystems	Ecosystem Description
MF	Mature Forest	Forests dominated by mature trees; includes **broadleaf** (MF:bd) forests, ***coniferous*** (MF:co) forests, and **mixed** (MF:mx) deciduous and coniferous forests; excludes mature riparian forests, and mature coniferous and broadleaf woodlands.
FS	Seasonally Flooded Agricultural Fields	Cultivated fields that flood annually, providing important migrating and wintering habitat for birds. These sites were formerly riparian or wetland ecosystems and may have some potential for restoration of these ecosystems.

11 Resource Information Standards Committee 2006
12 Pojar *et al.* 1991
13 Ward *et al.* 1998
14 Ward *et al.* 1998
15 Adapted from McPhee *et al.* 2000

Ecological Attributes

• **At-risk status** can be designated due to limited natural occurrence of an ecosystem or as the result of human activities. Most at-risk species or ecological communities in the study area are considered to be at-risk both because they are restricted in distribution and because their extent and densities have been reduced. At-risk ecological communities and wildlife species expected to occur in an ecosystem are listed in each of the sensitive ecosystems chapters (Chapters 6 to 17) (see sidebar).

BC Species and Ecosystems Explorer
http://www.env.gov.bc.ca/atrisk/toolintro.html
Check this web site for the current conservation status of rare plants, animals, and ecological communities, since the status of these may change over time.

Species at Risk Act
http://www.sararegistry.gc.ca/
Check this web site for species listings, assessments and details of the Act.

The Okanagan Valley provides habitat for a remarkable number of species at-risk including the western Rattlesnake (*Crotalus oreganus*), the Western-Screech Owl (*Megascops kennicottii macfarlanei*), and the Yellow-breasted Chat (*Icteria virens*) (Appendix II). Many of these have very restricted ranges, and some occur nowhere else in BC or Canada. Within the Province, species considered to be at-risk are placed on the BC Red and Blue lists[16]. Nationally at-risk species are ranked by COSEWIC (Committee on the Status of Endangered Wildlife in Canada), as ***Extirpated***, ***Extinct***, ***Endangered***, ***Threatened*** or of ***Special Concern***[17]. Endangered or Threatened species that have been included in Schedule 1 of the *Species at Risk Act* are afforded protection under the Act on Federal lands, and the new BC *Wildlife Amendment Act* (2004) will protect species populations and residences on Provincial lands. The primary mechanism for the protection of Species at Risk and their important habitats on private lands is through careful stewardship, land use planning and municipal bylaws. See Appendix II for a full list of at-risk wildlife species and Appendix III for a full list of at-risk plant species that occur in the study area.

• **Fragility** is a measure of an ecosystem's sensitivity to a range of ***disturbance*** factors that could lead to the decline or loss of ecosystem health or integrity. These factors include direct physical impacts, introduction and spread of invasive alien species, or ***fragmentation***. Many of the SEI ecosystem types are fragile and need to be considered on a site-by-site basis to limit negative effects of human activities.

• **High biodiversity** is a common feature of most SEI ecosystems, largely because of the proximity of the Okanagan Valley to grasslands in the south, and because of the variety of ecosystems in the landscape. This creates an ensemble of species at-risk not found elsewhere in Canada.

• **Specialized habitats** support many species of plants and animals and are often critical for at-risk species or ecological communities. Specialized habitats occur throughout SEI ecosystems. Some of these specialized habitats occur in only a few places in British Columbia or Canada, and their loss in the Okanagan Valley could result in the loss of these species nationally or globally (Table 4.)

16 **Red**-listed = rare and endangered; **Blue**-listed = at risk because of low or declining numbers

17 **Endangered** = facing imminent extirpation or extinction; **Threatened** = likely to become endangered if limiting factors are not reversed; **Special Concern** = particularly sensitive to human activities or natural events.

Table 4. Globally at-risk (imperiled or critically imperiled) species in the study area

Common Name	Scientific Name
Two-spiked moonwort	*Botrychium paradoxum*
Rusty cord-moss	*Entosthodan rubiginosus*
Nugget moss	*Microbryum vlassovii*

Socio-economic Values

• **Green Space** networks are provided by the various ecosystems in the study area. The diverse mix of species and ecosystems enhances the potential for human enjoyment and interaction with wildlife. Green space networks provide ***greenways***, such as riparian corridors or gullies, which can form the backbone of linear park systems that help provide connectivity of sensitive ecosystems.

• **Water quality** is provided by wetland and riparian ecosystems. These ecosystems safely capture, store and release water, filter pollutants and sediments, reduce flooding, and recharge aquifers.

• **High scenic values** are provided by rock outcrops, grasslands, and cliffs that offer excellent views of the landscape. These areas are often targeted for recreational and residential development. The scenic beauty of these and other ecosystems attract visitors and is a source of pride and pleasure for local residents.

• **Outdoor recreation** opportunities can be provided by sensitive ecosystems. Wildlife viewing is very important to Canadians[18], and contributes to the quality of life. Hunting, fishing, trapping and guide outfitting contribute to the economy and can occur where wildlife populations can sustain them.

• **Environmental education** is important at all levels of the school system from early childhood to university, and continuing education programs. Children and their families are learning directly about the need and means by which to care for the environment. Many schools are now working with local groups on projects (e.g., Streamkeepers and Wetlandkeepers[19]), with focus on conserving ecological communities and restoring wildlife habitat. Nature centres such as the Osoyoos Desert Centre and the Allan Brooks Nature Centre provide opportunities for local and regional community ecosystem conservation through educational programs, hands-on workshops and conservation-based recreational activities. A list of organizations and resources is provided in Appendix I.

• **Eco-tourism** is growing in economic importance. Annual events contribute significantly to the local economy by attracting visitors from well beyond the host community. Eco-tourism can also lead to increases in local commercial services like overnight accommodation, food concessions, and guided nature trips.

18 Environment Canada 1999
19 http://www.pskf.ca/

• **Resource industries** including activities such as ranching and forestry, have benefited generations of Okanagan residents. The remaining grasslands and forests continue to provide economic benefits through domestic grazing and logging.

• **Increased property value** is a benefit provided by green space and natural areas. The beauty of the natural landscape is often a large part of what attracts people to the Okanagan Valley. Studies show that undeveloped green space measurably increases the value of nearby property[20] by 15 to 30%[21] and thus, contributes far more in property taxes than it costs in services[22].

• **Horticulture and landscape industries** can benefit from the increased interest in native plant gardening and backyard wildlife habitat creation.

20 Meadows 1999
21 Curran 2001
22 Fodor 1999

3 Ecosystem Loss and Impacts of Concern

In the past 150 years, the incremental progression of human settlement, intensive agriculture, forest harvesting, ***fire suppression***, water management, and road, railway, and power line construction has resulted in loss or damage to natural ecosystems. In some areas, landscape fragmentation and ecosystem loss has created situations where once widespread ecosystems are now considered to be rare. The species that originally inhabited these ecosystems, from microscopic soil biota to large mammals, are also affected. Many of these species are now considered to be threatened and endangered.

Presently, pressures from urban and rural human settlement represent the greatest threat to sensitive ecosystems. Large-scale landscape concerns include landscape fragmentation, disruption of ***natural disturbance*** regimes, ***edge effects***, invasive species introductions and climate change.

Historical mapping dating back to 1800 indicates there have been dramatic levels of ecosystem loss in the Okanagan Valley. The majority of losses have resulted from agriculture, invasive plants, fire suppression and urban development. Over the past 200 years, ecosystem loss has been astounding and ranges between 3 and 91%. Most ecosystems have a minimum loss greater than 30%[23] (Table 5). Wetlands (Figure 3), grasslands (Figure 4), and coniferous woodland (Figure 5) loss between 1800 and 2005 is illustrated.

This historical mapping is based on TEM classification of current and historical airphotos and the collection of land use data from archives in the Okanagan Valley. Although the historical mapping categories do not perfectly correspond to the SEI categories mapped in this project, the information provided in Table 5 displays the trends in ecosystem loss from 1800 to 2005.

Table 5. Trends in ecosystem loss in the Okanagan Valley between 1800 and 2005[24].

Sensitive Ecosystem	Area of ecosystem coverage in 1800 (ha)	Area of ecosystem coverage in 1938 (ha)	Area of ecosystem coverage in 2005 (ha)	Percent Loss
Antelope-brush	8995	6420	2475	72%
Broadleaf Woodland	3715	3088	2084	44%
Coniferous Woodland	85,701	71,129	62,672	27%
Grassland	44,339	32,748	26,984	39%
Riparian	22,718	10,028	6109	73%
Sagebrush steppe	12,398	10,223	8263	33%
Sparsely Vegetated	6985	6764	6773	3%
Wetland	15,835	5071	1508	90.5%

23 Lea 2007
24 Lea 2007

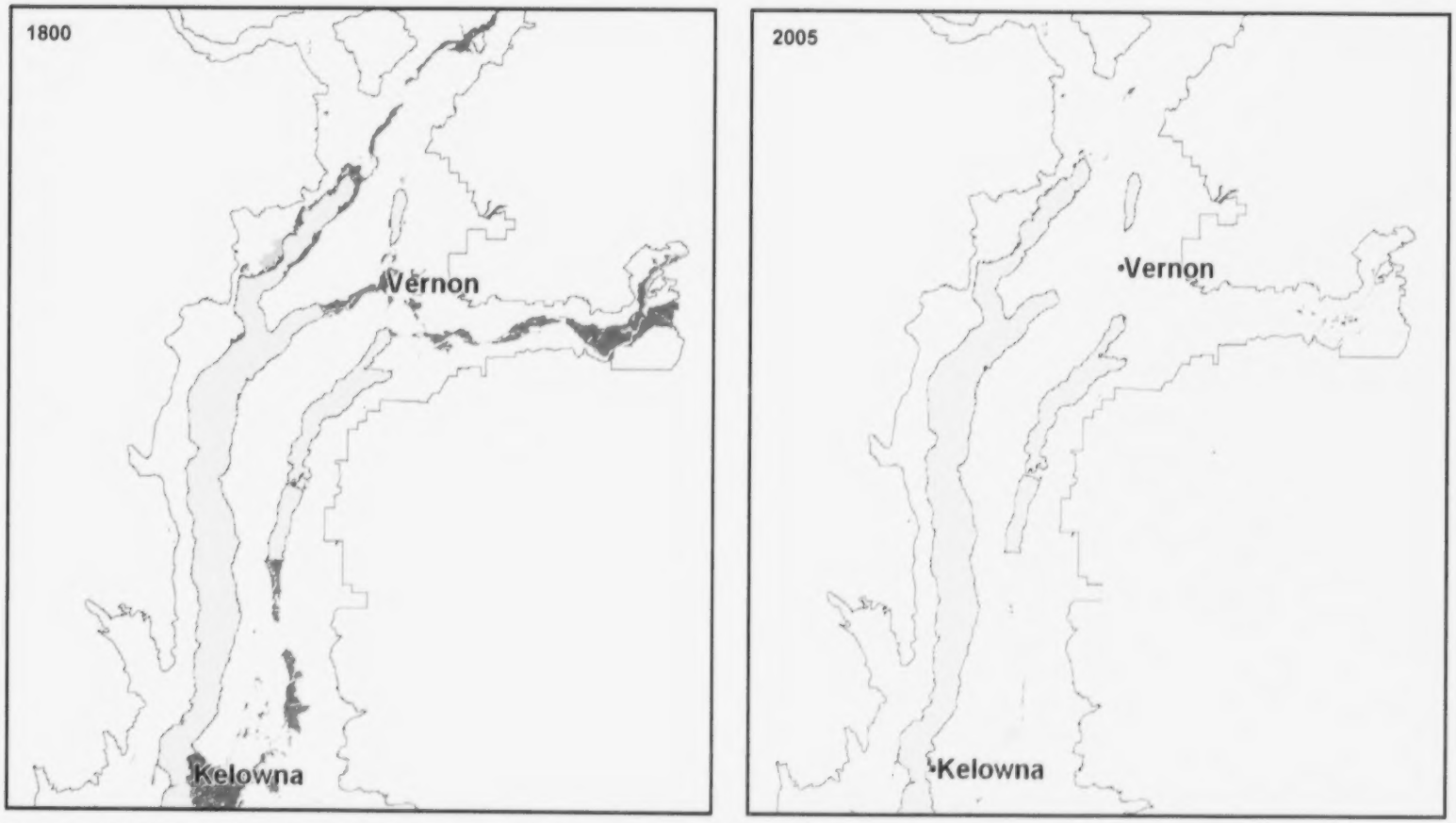

Figure 3. Historical mapping of a wetland ecosystem in 1800 compared to 2005. Mapping is based on the presence of the water birch – red-osier dogwood wetland shrub swamp ecosystem (mapped as a Riparian: shrub unit in this SEI project). Shading denotes the dominance of the water birch – red-osier dogwood wetland ecosystem in the polygon: dark orange denotes water birch – red-osier dogwood wetland is the dominate community; light orange denotes water birch – red-osier dogwood wetland is the secondary community; yellow denotes water birch – red-osier dogwood wetland is the tertiary community.

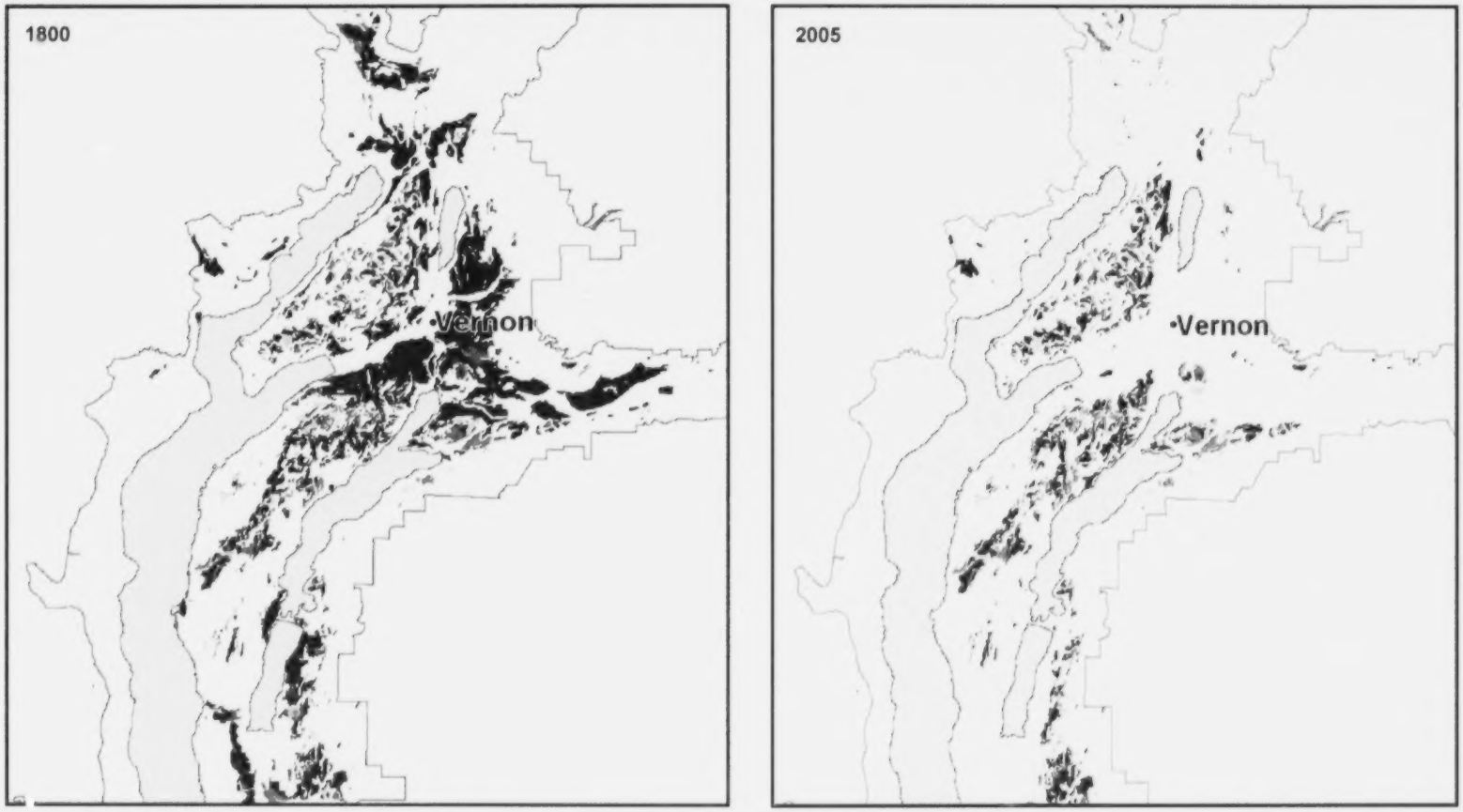

Figure 4. Historical mapping of a grassland ecosystem in 1800 compared to 2005. Mapping is based on the presence of the Idaho fescue – bluebunch wheatgrass grassland ecosystem. Shading denotes the dominance of the Idaho fescue – bluebunch wheatgrass community in the polygon: brown denotes Idaho fescue – bluebunch wheatgrass is the dominate community; orange denotes Idaho fescue – bluebunch wheatgrass is the secondary community; yellow denotes Idaho fescue – bluebunch wheatgrass is the tertiary community.

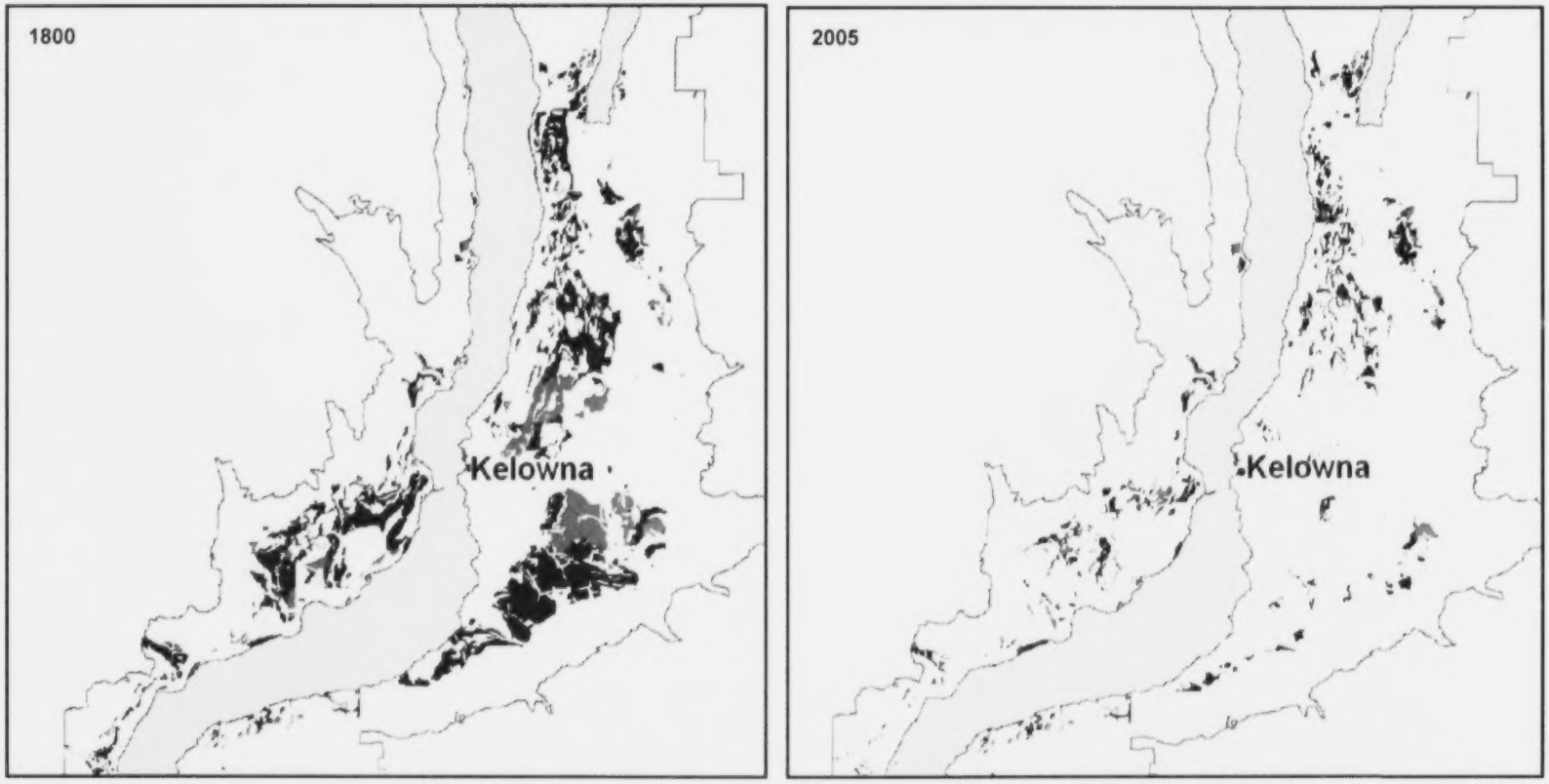

Figure 5. Historical mapping of a coniferous woodland ecosystem in 1800 compared to 2005. Mapping is based on the presence of the ponderosa pine-bluebunch wheatgrass ecosystem. Shading denotes the dominance of the ponderosa pine – bluebunch wheatgrass community in the polygon: dark green denotes ponderosa pine – bluebunch wheatgrass is the dominant community; light green that ponderosa pine – bluebunch wheatgrass is the secondary community; yellow denotes that ponderosa pine – bluebunch wheatgrass is the tertiary community.

Figure 6. An example of landscape fragmentation resulting from urban development. Housing developments have limited grassland and shrub community connectivity in the area of Middleton Mountain. (Photo credit: Kristi Iverson)

Landscape Fragmentation

Fragmentation of the landscape affects the functioning of ecosystems by disrupting habitat connectivity. Wildlife species require a network of corridors and habitats to maintain population levels and gene dispersal. Disconnected islands of natural ecosystems often cannot provide the necessary habitat values for wildlife species that require different ecosystem types for breeding, wintering, and foraging.

Urban and agricultural developments have been the primary agents of landscape fragmentation in the study area, particularly at low elevations (Figure 6). Roads and forestry cut blocks have also caused significant landscape fragmentation.

Edge Effects

Fragmentation of ecosystems contributes to the creation of 'edges'. Edges are places where there is an abrupt rather than natural, gradual change from one ecosystem type to another. Edge effects alter the habitat value of the original ecosystem by creating changes in microclimate elements such as temperature, light, and humidity[25], particularly in wetland and riparian ecosystems. Edge effects can alter the integrity of ecological communities and can reduce the habitat quality for plant and animal species and provide increased opportunities for the introduction and spread of invasive alien plants. Conversion of lands not only loses the amount of sensitive ecosystems, but the remaining natural landscape has much more edge than would naturally occur.

25 Chen *et al.* 1995; Saunders *et al.* 1991

Figure 7. An example of a high intensity, stand replacing fire. High intensity fires are a result of fire suppression and the accumulation of fire fuels. These fires destroy habitat and alter stand structure. (Photo credit: John Grods)

Disruption of Natural Disturbance Regime

A major landscape level change has been the exclusion and suppression of natural fires. Ecosystems and species of the Okanagan Valley have evolved with natural fires as an important factor in ecosystem development and habitat distribution. Frequent ***surface fires*** maintained open forests and grassland ecosystems. Fire exclusion and fire suppression have resulted in ***forest ingrowth*** and ***forest encroachment***. Fire suppression also results in extensive fuel accumulations, which combined with forest ingrowth, has altered the ***fire regime*** from low-to-moderate severity surface fires[26] to high severity, ***stand-replacing fires***[27] such as the Okanagan wildfires of 2003 (Figure 7). Additionally, increased tree densities in forests have stressed trees making them more susceptible to diseases such as mistletoe and insect pests such as spruce budworm. These factors, together with altered ***understory*** composition, have affected both ecosystem processes and wildlife habitat values.

Another major landscape level change in the study area is the channelization of riparian ecosystems to prevent flooding. Preventing natural flood events reduces the diversity, site productivity and complexity of wetland and riparian ecosystems, and alters habitat values, resulting in loss of some functions and part of the riparian habitat.

26 See ***fire severity*** in the glossary.
27 Moore *et al.* 1999; Fule *et al.* 1997; Daigle 1996

Invasive Alien Species

The deliberate and accidental introduction of alien plant and animal species (see sidebar) has significantly altered species composition of some ecosystems. Invasive alien plant species reduce diversity by displacing native plant species and changing vegetation structural complexity. Invasion of alien plants can result in loss of forage and cover for many wildlife species and potentially a loss of breeding sites. Improperly managed grazing by domestic animals can exacerbate alien plant invasions, particularly in grasslands and wetlands where exposed soils provide excellent sites for alien and weedy native species capable of colonizing newly disturbed areas. Recreational vehicles, animals, and people all cause the spread of alien plants. Many alien plants have seeds that survive in the soil for decades; consequently, alien plant control must be considered a long-term process.

Grasslands, sagebrush steppe, antelope-brush steppe, old forests, coniferous woodlands, and sparsely vegetated ecosystems are vulnerable to invasion by cheatgrass (*Bromus tectorum*) and other alien brome species (*Bromus* spp.), diffuse knapweed (*Centaurea diffusa*), sulphur cinquefoil (*Potentilla recta*), and many other alien plants (Figure 8). Riparian ecosystems and broadleaf woodlands are particularly vulnerable to invasion by common hound's-tongue (*Cynoglossum officinale*) and common burdock (*Arctium minus*). Wetland ecosystems can be completely altered if purple loosestrife (*Lythrum salicaria*) or yellow flag iris (*Iris pseudacorus*) become established.

Aquatic ecosystems have also been affected by the introduction of many species. Non-native fish have been introduced into many places, and now actively compete with native species. Mysid Shrimp (*Mysis relicta*) were introduced into Okanagan Lake to provide food for kokanee salmon. Instead of providing food, the shrimp fed on phytoplankton that the kokanee fry depended on, and the kokanee population subsequently declined[28].

For this SEI, invasive alien plants are defined as non-native plants which lack the natural enemies necessary to restrict their distribution.
Noxious weeds are aggressive invasive plants that are designated under the provincial ***Weed Control Act****.*
The Invasive Plant Council of British Columbia has compiled an Invasive Plant Strategy for British Columbia available at http://www.invasiveplantcouncilbc.ca/publications/invasive-plant-strategy.pdf

Climate Change

Climate change is being widely accepted as a major ecological disturbance[29]. Climate change effects will likely vary from region to region, and the long-term consequences are uncertain. Maintaining ecological functions, processes and genetic diversity may provide ecosystems with the resiliency to absorb or mitigate some of these effects. Maintaining species populations at the edges of their range may enhance species survival[30]. Keeping a corridor through the Okanagan Valley is one component to maintaining connectivity between the drier ecosystems of interior BC and the southern US. This connective corridor will be critical for the dispersal and conservation of many dryland species that may move to more northern latitudes or to higher elevations with warmer temperatures.

28 Ashley *et al.* 1999
29 United Nations Environment Program 1999
30 Scudder 1991

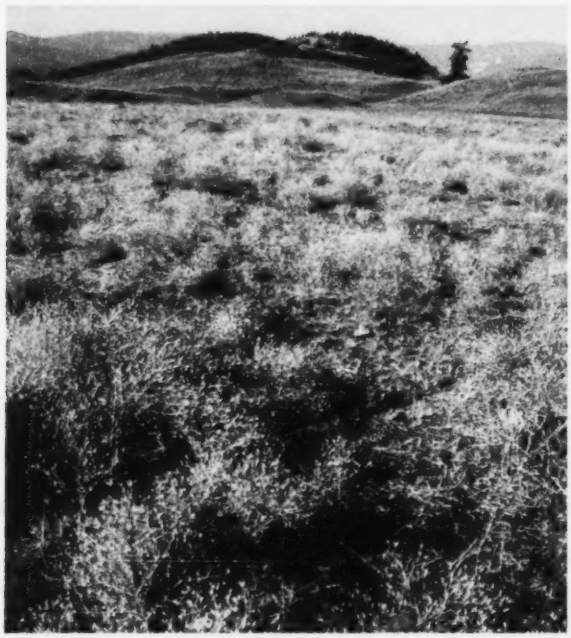

Figure 8. Example of damage to grassland ecosystem from diffuse knapweed, an alien invasive plant. Diffuse knapweed has displaced native species, some of which are red- or blue-listed. (Photo credit: Kristi Iverson)

Figure 9. Damage to ecosystems. In the study area, activities such as mountain biking have caused soil erosion and exacerbated the spread of invasive plants like knapweed.

Some invasive alien plant species:
Diffuse knapweed (*Centaurea diffusa*)
Eurasian milfoil (*Myrophyllum spicatum*)
Sulphur cinquefoil (*Potentilla recta*)
Cheatgrass (*Bromus tectorum*) and other annual bromes (*Bromus* spp.)
Common hound's-tongue (*Cynoglossum officinale*)
Common burdock (*Arctium minus*)
Purple loosestrife (*Lythrum salicaria*)
Common St. John's wort (*Hypericum perforatum*)
Yellow flag iris (*Iris pseudacorus*)

Some invasive alien animal species:
European Starling (*Sturnus vulgaris*)
Dogs (*Canis* spp.)
Cats (*Felis* spp.)
Mysid Shrimp (*Mysis relicta*)
Bullfrogs (*Rana catesbeiana*)
Brook Trout (*Salvelinus fontinalis*)
Bass (*Micropterus* spp.)
Black Crappie (*Pomoxis nigromaculatus*)
Many agricultural pests

Mountain Pine Beetle

The mountain pine beetle has significantly affected ecosystems across BC. By 2007, 13 million hectares of forest land had been infested by the mountain pine beetle. The high component of ponderosa pine and lodgepole pine in the Okanagan Valley makes the area especially vulnerable to outbreaks. Old forests, mature forests, woodlands, and coniferous riparian ecosystems are all at risk of further and significant ecosystem degradation resulting from the mountain pine beetle. The loss of ponderosa pine and lodgepole pine from the overstory of these ecosystems will result in significant changes in stand structure and understory composition, consequently altering habitat values.

Direct Impacts

Direct impacts to ecosystems are those which occur on site and which have the most immediate and visible effect. Vegetation removal or damage, and soil removal or compaction are examples of immediate and visible effects. Disturbances to wildlife species, particularly during the breeding season can directly impact survival. Large rural lots have the potential to retain many natural values; however, many owners choose to remove native vegetation, trees, snags, logs, and rocks, and intensely manage or graze domestic animals, thus directly impacting the natural values of these areas.

Indirect Impacts

Activities that occur adjacent to or away from the ecosystem may result in indirect impacts. Changes in ***hydrology*** due to diverted watercourses and water flow, deforestation, removal of vegetation and soil, changes in vegetation structure (e.g., from shrub cover to ***herbaceous*** alien plants), increased impervious road surfaces, soil compaction and agricultural practices can all result in reduced groundwater infiltration and soil moisture. Increased annual ***runoff*** and flood events, disrupted drainage patterns, and reduced soil moisture holding may also result. Water pollution from point and non-point sources alter plant communities and contribute to reduced water quality and increased outbreaks of water-borne disease that can impact wildlife populations. Pesticide use associated with agriculture and landscaping has caused degradation of natural ecosystems and wildlife habitat[31].

31 Cannings and Durance 1998

Figure 10. Changes in ecosystems structure due to fire suppression. Most forests in the study area have become dense and ingrown with the exclusion of fire and the selection logging of large old veteran trees. Forest ingrowth has altered the ecological and economic values of these ecosystems.

Figure 11. Invasive alien species. Cheatgrass (*Bromus tectorum*), an introduced annual grass, is observed as a common invasive species that has invaded many grasslands and open forests.

Figure 12. Historical stand structure prior to fire suppression. Historically, open grown forests like this one dominated the landscape. Currently, such forests are largely limited to sites with shallow soils, and in the few places where logging has not occurred.

4 Methods and Limitations

This chapter describes the two methods that were used to generate the sensitive ecosystems maps: 1) most projects used the provincially recognised Terrestrial Ecosystem Mapping[32] (TEM) approach as a base. Ecosystems from the TEM project were evaluated for sensitive ecosystem status and a sensitive ecosystems theme map was developed; and 2) a direct map of the Sensitive Ecosystems was developed using air photo interpretation.

Terrestrial Ecosystem Mapping

Terrestrial Ecosystem mapping (TEM) was used as the foundation for the SEI thematic mapping (Table 6). Sensitive ecosystems were mapped directly for the Naramata SEI.

In most of these TEM projects, ***polygons*** were delineated on 1:15,000 colour ***aerial photographs*** using a ***bioterrain*** approach. Polygons were drawn around areas of uniform vegetation, topography and terrain features. Ecosystem, terrain, and conservation evaluations were recorded in a database. The polygons were digitally transferred using monorestitution and compiled in a geographic information system (GIS), and linked to the database. Projects with deviations from the standard TEM approach are discussed below.

The South Okanagan SEI was first completed in 1990-1994 as a biophysical mapping project (then called the South Okanagan Biophysical Habitat Mapping) following procedures similar to TEM, but pre-dating the development of the TEM standard[33]. Polygons were delineated on 1:15,000 colour aerial photographs from the mid-1980s. Polygon delineation is generally less detailed than in other project areas.

In 2005, the biophysical mapping was updated to the TEM standard. Biophysical habitat classes were evaluated and compared to TEM ecosystem units. Where there was a direct correlation between habitat classes and ecosystem units, an algorithm was used to update the mapping. Where there was not a direct correlation, polygons were evaluated and mapped in stereoscopic view. All polygons with antelope-brush growing in them were also evaluated stereoscopically[34].

Colour orthophotos from 2003 were used to update the mapping for recent urban and agricultural developments. Areas of development were digitized from the orthophotos to create new polygons.

32 Resources Inventory Committee 1998
33 Lea *et al.* 1991; Harper *et al.* 1996
34 Iverson *et al.* 2005

Table 6. SEI projects and metadata

Project	Date of Aerial *Photographs*	Date and source of updates
Bella Vista – Goose Lake Range SEI	1994[35]	2002 field sampling
Central Okanagan SEI	1994	2000-2001 field sampling 2003 orthophotos and additional field sampling for the Ellison area in 2005 2006 aerial photographs for South Slopes area that was burned in 2003
City of Kelowna SEI	2006	2007 field sampling
Coldstream - Vernon SEI	1994	2003 orthophotos and 2007 field sampling
District of Lake Country SEI	1994	2003 orthophotos and 2005 field sampling
Joe Rich SEI	1994	2003 orthophotos and 2006 field sampling
South Okanagan SEI[36]	1985	1990s original field sampling 2003 orthophotos 2004 orthophotos of Okanagan Mountain Park 2004-2005 winter field sampling of areas with antelope-brush only
TFL 15 TEM	1996	1998 field sampling
Vernon Commonage SEI	1994	2003 orthophotos and 2005 field sampling

For areas that burned in the 2003 wildfires, forested ecosystems were presumed to have returned to the shrub structural stage except within Okanagan Mountain Park, where post-fire orthophotos were used to update the structural stage of forested ecosystems.

In 2006, some small gaps between the South Okanagan SEI, Naramata SEI and TFL 15 TEM were mapped to TEM standard using a mixture of mid-1980s and 1994 aerial photographs together with 2003 colour orthophotos. In 2006 the portion of the project that lies within the Naramata Official Community Plan was upgraded to provide more detailed mapping of riparian and wetland ecosystems. Riparian areas and wetlands were delineated on the original aerial photographs

35 Iverson 2002
36 Iverson 2006

to form new polygons that were pure SEI units where possible. These lines were digitally captured using the existing polygon boundaries as controls.

The Kelowna SEI was digitally mapped using a DiAP Viewer. In 2005, the area had draft bioterrain mapping completed using 1:10 000 scale, year 2003, colour digital imagery. Final bioterrain, TEM and SEI mapping was completed in 2007-8 using 1:10,000 scale, year 2006, colour digital imagery.

Sensitive Ecosystems Mapping from TEM

TEM ecological units were evaluated for at-risk status and ecological sensitivity then assigned to sensitive ecosystem categories and other important ecosystem categories accordingly. Criteria for ecological sensitivity included the presence of shallow soils, the susceptibility of the site to hydrological changes, erosion, the introduction and spread of invasive plants, and sensitivity associated with human disturbance. At-risk status was based on rankings by the B.C. Conservation Data Centre (CDC). If the ecosystem was determined to be ecologically sensitive or rare, it was assigned to the applicable sensitive ecosystems category. In cases where a given ecosystem could be assigned to more than one Sensitive Ecosystems category, it was always assigned to the more sensitive category.

Ecosystems were grouped into sensitive ecosystems categories using the Ecosystem-based Resource (ERM) Table Tool[37]. This tool allows ratings, or in this case, SEI categories, to be assigned to each ecosystem.

Naramata SEI Methods

The Naramata SEI used bioterrain polygons from the Okanagan Dry Belt Predictive Ecosystem Mapping (PEM)[38]. The PEM bioterrain polygons were interpreted for sensitive ecosystems using air photo interpretation and where necessary were split into smaller polygons to better represent sensitive ecosystem content. New polygons were delineated where gaps occurred between the PEM bioterrain polygons and the South Okanagan SEI. Each polygon was evaluated for rarity and ecological sensitivity, and was assigned to the appropriate SEI class and subclass[39]. A limited amount of field verification took place in the early spring of 2005.

Mapping Limitations

The SEI information is intended to alert local and regional decision-makers to the presence of sensitive and important ecosystems and ecological features. The SEI mapping does not replace the need for on-site assessments in areas where land use changes are proposed.

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37 See the following website for more information on the ERM tools and to download ERM tools: http://www.env.gov.bc.ca/wildlife/whr/sta.html

38 JMJ Holdings Ltd. 2002

39 Iverson *et al.* 2003

The accuracy of polygon boundaries is limited by the scale (1:15,000 for all projects except the City of Kelowna which was based on 1:10,000 digital aerial photographs) and date of the aerial photographs on which the sites are delineated. It is recommended that digital data not be enlarged beyond the scale of the photos as this may result in unacceptable distortion and faulty registration with other data sets.

Given the continuing land uses within the Okanagan, including human settlement and logging, some polygons may have changed since the date that the aerial photographs were taken or the field sampling was conducted. Wherever possible, polygons were updated to reflect change.

The SEI mapping does not replace the need for on-site assessments in areas where land use changes are proposed.

One of the primary limitations of aerial photograph interpretations is the ability to see specific disturbances such as the introduction and spread of invasive plants. The mapper must apply the information from field sampling data to adjacent areas. Furthermore, disturbance levels may have changed in some areas after the field sampling was completed.

The ability to delineate polygons around small sensitive ecosystems is a limitation of SEI. In most cases, these ecosystems are captured as a small component of a larger polygon that is dominated by another ecosystem. It is important to remember that many polygons contain a complex of ecosystems, and sensitive ecosystems may only occupy a portion of that polygon.

5 Inventory Results

This chapter provides a summary of the distribution and extent of sensitive ecosystems and other important ecosystems in the study area. Further details can be found in each of the ecosystem chapters (Chapters 6 to 17).

SEI Summary Results

Ten 'sensitive ecosystem' categories and two 'other important ecosystem' categories were identified. Collectively the ten sensitive ecosystems covered 47.9% (194,322 ha) of the study area (Table 7). The two other important ecosystems (OIE) covered 7.9% (29,072 ha) of the study area. Large lakes covered 5.9% or 21,866 ha. Lakes have been removed from the results calulations to avoid misrepresenting the sensitive and other important ecosystem proportions. The results tables that follow include only the terrestrial portion of the study area (347,565 ha.)

Coniferous woodlands and grasslands were the sensitive ecosystems with the greatest abundance across the landscape, accounting for 14.7% and 10.8%, respectively. Alpine, broadleaf woodlands and antelope-brush steppe ecosystems accounted for the smallest proportion of sensitive ecosystems with 0.1%, 0.5% and 0.9%, respectively.

Of the three regional districts in the study area, the Regional District of the Okanagan-Similkameen (RDOS) (Table 8) contained the highest proportion of sensitive ecosystems, followed by the Regional District of the North Okanagan (RDNO) (Table 9) and the Regional District of the Central Okanagan (Table 10) with 54.7%, 40.5% and 31.1%, respectively.

Ecosystems that have not been included as sensitive ecosystems or other important ecosystems still have many important values. In particular, ecosystems that provide connectivity between sensitive ecosystems and OIEs and those that provide recruitment sites for future sensitive ecosystems and OIEs are very important. Many ecosystems provide valuable wildlife habitat, while others contribute to the hydrology of the watershed. Vegetation and soils are important for the safe capture, storage, and release of water, which is critical to maintaining water quality and preventing soil erosion and siltation of streams and rivers.

Table 7. Overall area of sensitive ecosystems and other important ecosystems in the project area (347,565 ha[40]).

	Area (ha)	Percent of Area Mapped in the Study Area[41]
Sensitive Ecosystems (SE)		
Alpine	520	0.1
Antelope-brush Steppe	3171	0.9
Broadleaf Woodland	1737	0.5
Coniferous Woodland	50,971	14.7
Grasslands	37,506	10.8
Old Forest	16,194	4.7
Riparian	18,879	5.4
Sagebrush Steppe	8535	2.5
Sparsely Vegetated	26,023	7.5
Wetland	4751	1.4
Total SE	**194,322**	**47.9%**
Other Important Ecosystems (OIE)		
Mature Forest	25,048	7.2
Seasonally Flooded Agricultural Fields	2291	0.7
Total OIE	**29,072**	**7.9%**
TOTAL SEI and OIE	**223,395**	**55.8%**

40 Total area excludes area mapped as lakes. Total area of lakes mapped in the study area is 21,866 ha. Total area mapped in the study area including lakes is 369,431 ha.

41 This is a percent of the area excluding lakes.

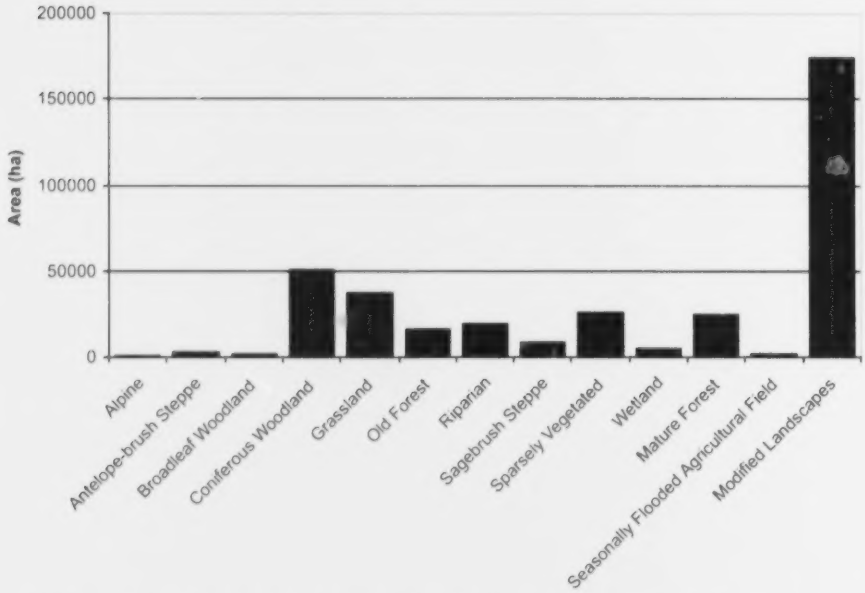

Figure 13. Relative proportion of sensitive ecosystems and modified landscapes in the study area.

Table 8. Area of sensitive ecosystems and other important ecosystems in the Regional District of the Okanagan-Similkameen (RDOS). This table includes results for the South Okanagan TEM, Naramata SEI, and TFL15 TEM projects[42] (241,269ha[43]).

	Area (ha)	Percent of Area Mapped in RDOS[44]
Sensitive Ecosystems (SE)		
Alpine	520	0.2
Antelope-brush Steppe	3171	1.3
Broadleaf Woodland	874	0.4
Coniferous Woodland	36,113	15.0
Grasslands	26,284	10.9
Old Forest	15,282	6.3
Riparian	14,634	6.1
Sagebrush Steppe	8535	3.5
Sparsely Vegetated	23,251	9.6
Wetland	3366	1.4
Total SE	**132,030**	**54.7%**
Other Important Ecosystems (OIE)		
Mature Forest	19,904	8.2
Seasonally Flooded Agricultural Fields	1993	0.8
Total OIE	**21,897**	**9.0%**
TOTAL SEI and OIE	**153,927**	**63.7%**

42 Both the Naramata SEI and TFL15 TEM overlap slightly with the South Okanagan TEM. The Naramata and TFL15 projects were clipped to edge-match to the South Okanagan TEM for the purposes of producing these results.

43 Total area excludes area mapped as lakes. Total area of lakes mapped in the RDSO is 17,624 ha. Total area mapped in the RDSO including lakes is 258,893 ha.

44 This is a percent of the area excluding lakes.

Table 9. Area of sensitive ecosystems and other important ecosystems in the Regional District of the North Okanagan (RDNO). This table includes results for the Bella Vista TEM, Vernon Commonage TEM, and Coldstream – Vernon TEM projects (33,337 ha[45]).

	Area (ha)	Percent of Area Mapped in RDNO[46]
Sensitive Ecosystems (SE)		
Alpine	0	0
Antelope-brush Steppe	0	0
Broadleaf Woodland	677	2.0
Coniferous Woodland	3010	9.0
Grasslands	6137	18.4
Old Forest	490	1.5
Riparian	1438	4.3
Sagebrush Steppe	0	0
Sparsely Vegetated	1312	3.9
Wetland	475	1.4
Total SE	**13,539**	**40.5%**
Other Important Ecosystems (OIE)		
Mature Forest	948	2.8
Seasonally Flooded Agricultural Fields	173	0.5
Total OIE	**1121**	**3.3%**
TOTAL SEI and OIE	**14,660**	**43.8%**

45 Total area excludes area mapped as lakes. Total area of lakes mapped in the RDNO is 288 ha. Total area mapped in the RDNO including lakes is 33,625 ha.

46 This is a percent of the area excluding lakes.

Table 10. Area of sensitive ecosystems and other important ecosystems in the Regional District of the Central Okanagan (RDCO). This table includes results for the City of Kelowna, Central Okanagan, Central Okanagan South Slopes, and District of Lake Country TEM projects (72,959 ha[47]).

	Area (ha)	Percent of Area Mapped in the Study Area[41]
Sensitive Ecosystems (SE)		
Alpine	0	0.0
Antelope-brush Steppe	0	0.0
Broadleaf Woodland	187	0.3
Coniferous Woodland	11,848	16.2
Grasslands	5086	7.0
Old Forest	422	0.6
Riparian	2807	3.8
Sagebrush Steppe	0	0
Sparsely Vegetated	1460	2.0
Wetland	910	1.2
Total SE	**22,720**	**31.1%**
Other Important Ecosystems (OIE)		
Mature Forest	4195	5.8
Seasonally Flooded Agricultural Fields	125	0.2
Total OIE	**4320**	**6.0%**
TOTAL SEI and OIE	**27,040**	**37.1%**

47 Total area excludes area mapped as lakes. Total area of lakes mapped in the RDCO is 3929 ha. Total area mapped in the RDCO including lakes is 76,888 ha.
48 This is a percent of the area excluding lakes.

6 Wetland

What are wetland ecosystems?

Wetlands occur on sites where the water table is at, near, or above the soil surface for a sufficient period of time to influence soil and vegetation development[48]. Wetland ecosystems characteristically have plants that are adapted to growing on saturated soils with low oxygen levels for much of the year. Soils are typically gleysols or organic. Within British Columbia, approximately 6% of the total land area is covered by wetlands[49].

For this study, wetlands were divided into distinct classes according to their environmental and vegetation characteristics. These classes included marshes, swamps, fens, wet meadows and shallow open water ecosystems.

Marsh wetland ecosystems

Marsh wetland ecosystems occur at the edge of shallow open water, ponds, and lakes, on the edges of larger wetlands, and in depressions where the water table is above or near the soil surface. Rushes, cattails, or sedges usually dominate marshes, and some floating aquatics such as duckweed and water smartweed are often present. Soils are typically fine-textured, gleysol mineral soils.

Swamp wetland ecosystems

Swamp wetland ecosystems occur at the edges of ponds and wetlands, forming a shrubby fringe, and at higher elevations in areas where subsurface water flow (sub-irrigation) is significant. Willows typically dominate the edges of ponds and wetlands. Spruce and abundant horsetails dominate many higher elevation swamps with lots of sub-irrigation. Soil textures are variable and mottles are common.

48 MacKenzie and Banner 1999
49 Voller 1998

Fen wetland ecosystems

Fen wetland ecosystems occur at high elevations where organic material (peat) has accumulated. Fens have both mineral-rich groundwater and precipitation as sources of water. Fens are dominated by sedges, often with willows, and have abundant brown mosses with some peat-mosses. Sites with less mineral-rich groundwater have more peat-mosses.

Wet meadow ecosystems

Wet meadow ecosystems occur as a fringe at the edges of ponds, shallow open water and marshes, and sometimes on their own in depressions. Alkaline sites, indicated by a white soil crust, are dominated by baltic rush, alkaligrass, foxtail barley, or saltgrass. Sedges, baltic rush, and some grasses tolerant of a high water table occur on non-alkaline sites. Wet meadows occur where the water table is at or above the soil surface for only a short portion of the growing season. Sites may have surface water in the spring but are dry at the surface by early summer.

Table 11. Wetland ecosystem vegetation. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

	Swamp	Marsh	Fen	Shallow Water	Wet Meadow	
Trees						
hybrid white spruce	**					*Picea engelmannii x glauca*
Shrubs						
willows	***					*Salix* spp.
red-osier dogwood	**					*Cornus stolonifera*
mountain alder	*					*Alnus incana*
Grasses, Sedges & Rushes						
sedges	***	**	***		*	*Carex* spp.
bluejoint	**	*	*			*Calamagrostis canadensis*
rushes		**				*Schoenoplectus and Scirpus* spp.
narrow-leaved cotton-grass			**			*Eriophorum angustifolium*
Baltic rush					**	*Juncus balticus*
alkaligrass					**	*Puccinellia* sp.
foxtail barley					**	*Hordeum jubatum*
seashore saltgrass					**	*Distichlis spicata*
Forbs						
cattail		**				*Typhus latifolia*
duckweed		**		**		*Lemna minor*
pondweeds				*		*Potamogeton* spp.
Mosses						
glow moss	*	**	*			*Aulacomnium palustre*
peat-mosses	*		***			*Sphagnum* spp.
brown mosses	*		***			various species

Shallow open water ecosystems

Shallow open water ecosystems are either areas of open water that are intermittently or permanently flooded up to 2 m in depth at midsummer[50], or ponds that are greater than 2m in depth, but are less than 50 ha in area. Vegetation is limited to submerged or floating aquatic plants with less than 10% cover of ***emergent vegetation***. Shallow open water ecosystems often occur in association with marshes.

Wildlife

Invertebrates: Wetlands are highly productive sites for insects, and healthy wetland ecosystems host a large variety of invertebrates, including many rare species of dragonflies and damselflies, which feed on other insects such as mosquitoes and provide food for other wildlife.

Amphibians & Reptiles: All Okanagan amphibians, including rare frogs and salamanders, require wetlands for breeding, and the developing young require wetlands for food and shelter. Painted turtles require wetlands for food and shelter, as well as permanent and relatively deep ponds for overwintering. Many snakes forage in and around wetlands.

Birds: Most birds require water for drinking, but wetlands also provide foraging and nesting habitat for numerous shorebirds and waterfowl, including many rare species. Wetlands are very important foraging areas for insect-eating songbirds. Many predatory birds will hunt around wetlands, as prey is often abundant.

Mammals: Wetland edges are extremely productive sites for small mammals such as shrews and rodents, and the carnivores that feed on them. These insect-rich sites also provide important foraging habitat for many species of bats, including some rare species.

Why are they important?

Ecological and socio-economic values of wetland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **At-risk status**: B.C. Conservation Data Centre lists most wetland ecological communities as at-risk (Table 12), as well as numerous plant (Table 13) and wildlife species (Table 14).
- **High biodiversity:** Small ponds, marshes, and even man-made wetlands are focal points for wildlife because of their infrequent occurrence in this landscape. Wetlands provide wildlife and biodiversity values that are disproportionate to the area they occupy on the land base. Wetland vegetation provides food, shelter, breeding habitat, and cover for many species of amphibians, reptiles, mammals, birds, and insects, including many aquatic

50 Voller 1998

organisms. Ponds and shallow open water bodies are important watering sites for many species and provide painted turtle habitat, especially if floating logs are present. Wetlands are also highly productive sites for insects, which provide an important source of food to birds and bats.

- **Fragility:** Wetlands are vulnerable to a range of human disturbances such as removing vegetation, dredging, diking, or filling. Small changes in hydrology such as reduced flows or lowered water tables, and urban run-off and other sources of nutrients including fertilizers and livestock manure can change and reduce the diversity of wetland communities. Intensive recreational activities such as mud-bogging on wetland edges can reduce plant cover, compact soil, and disturb nesting birds, basking turtles, and breeding or developing amphibians and invertebrates. Additionally, wetlands are vulnerable to overuse by livestock. Wetlands that have been overused by livestock are still extremely valuable and many of these sites recover quickly with improved management.
- **Maintenance of water quality:** Properly functioning wetlands store and filter water, and maintain water quality. They reduce the levels of sediment, nutrients, and toxic chemicals in outflow water.
- **Social values:** Wetlands provide opportunities for education, bird watching, and aesthetic enjoyment. The green space that wetlands provide can add to real estate values in adjacent areas and can act as a tourist draw.

Status

Wetland ecosystems are extremely rare in the study area, and have been significantly impacted by human activities. More than 90% of the wetland area has been lost in the Okanagan Valley since 1800[51]. Currently, wetlands occupy only 1.4% or 4751 ha of the land base. Steep topography limits the occurrence of wetlands; however reduced numbers also exist due to infilling of wetlands. In addition, the hydrology of wetlands has changed due to land use practices in the surrounding area. For example, in the area between Penticton and Osoyoos, 85-90% of large marshes have been lost[52]. Agriculture, urban and suburban settlement and development, forestry, and flood control have all affected wetlands in the study area.

51 Lea 2007
52 Voller 1998

Table 12. At-risk ecological communities of wetland ecosystems

Common Name	Scientific Name	Provincial Status
Baltic rush - common silverweed	*Juncus balticus - Potentilla anserina*	Red
Hairy water-clover - Olney's bulrush	*Marsilea vestita - Schoenoplectus americanus*	Red
Narrow-leaf willow - peach-leaf willow	*Salix exigua - Salix amygdaloides*	Red
Nuttall's alkaligrass - foxtail barley	*Puccinellia nuttalliana - Hordeum jubatum*	Red
Baltic rush - field sedge	*Juncus balticus - Carex praegracilis*	Blue
Common cattail Marsh	*Typha latifolia* Marsh	Blue
Hard-stemmed bulrush Deep Marsh	*Schoenoplectus acutus* Deep Marshs	Blue
Narrow-leaved cotton-grass - shore sedge	*Eriophorum angustifolium - Carex limosa*	Blue
Tufted clubrush / golden star-moss	*Trichophorum cespitosum/Campylium stellatum*	Blue

Table 13. At-risk plants of wetland ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Mexican Mosquito Fern	*Azolla mexicana*	Threatened	Red
Cut-leaved Water Parsnip	*Berula erecta*		Red
River Bulrush	*Bolboschoenus fluviatilis*		Red
Bearded Sedge	*Carex comosa*		Red
Porcupine sedge	*Carex hystricina*		Blue
Many-headed Sedge	*Carex sychnocephala*		Blue
Fox Sedge	*Carex vulpinoidea*		Blue
Annual Paintbrush	*Castilleja minor* ssp. *minor*		Red
Crested Wood Fern	*Dryopteris cristata*		Blue
Beaked Spike-rush	*Eleocharis rostellata*		Blue
Nuttall's Waterweed	*Elodea nuttalli*		Blue
Giant Helleborine	*Epipactis gigantea*	Special Concern	Blue
Rusty Cord-moss	*Entosthodon rubiginosus*	Endangered	Red
Hutchinsia	*Hutchinsia procumbens*		Red
False Pimpernel	*Lindernia dubia var. anagallidea*		Blue
Hairy Water-clover	*Marsilea vestita*		Red
Dotted Smartweed	*Polygonum punctatum*		Blue
Bushy Cinquefoil	*Potentilla paradoxa*		Red
Peach-leaf Willow	*Salix amygdaloides*		Red
Tweedy's Willow	*Salix tweedyi*		Blue
Olney's bulrush	*Schoenoplectus americanus*		Red

Annual Paintbrush
(Photo credit: Sara Bunge)

Painted turtles on a log in a wetland ecosystem

Table 14. At-risk wildlife of wetlands

Common Name	Scientific Name	Federal Status	Provincial Status
Lance-tipped Darner	*Aeshna constricta*		Red
Emma's Dancer	*Argia emma*		Blue
Vivid Dancer	*Argia vivida*		Red
Western Pondhawk	*Erythemis collocata*		Blue
Twelve-spotted Skimmer	*Libellula pulchella*		Blue
Blue Dasher	*Pachydiplax longipennis*		Blue
Autumn Meadowhawk	*Sympetrum vicinum*		Blue
Northern Leopard Frog	*Rana pipiens*	Endangered	Red
Western Toad	*Bufo boreas*	Special Concern	-
Great Basin Spadefoot	*Spea intermontana*	Threatened	Blue
Tiger Salamander	*Ambystoma tigrinum*	Endangered	Red
Painted Turtle	*Chrysemys picta*	Special Concern	Blue
Winged Floater	*Anodonta nuttalliana*		Blue
Attenuate Fossaria	*Fossaria trunculata*		Blue
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue
Western Grebe	*Aechmophorus occidentalis*		Red
Great Blue Heron	*Ardea herodias herodias*		Blue
American Bittern	*Botaurus lentiginosus*		Blue
Sandhill Crane	*Grus canadensis*		Blue
American Avocet	*Recurvirostra americana*		Red
Western Small-footed Myotis	*Myotis ciliolabrum*		Blue
Fringed Myotis	*Myotis thysanodes*		Blue

7 Riparian

What are riparian ecosystems?

In this study, riparian ecosystems are defined as ecosystems that are adjacent to, and significantly influenced by a water body. These sites tend to be moister than, and have a ***plant community*** that is distinct from the surrounding upland. Riparian ecosystems are typically linear in nature. In the study area, soils are typically gleysols, although ***regosols*** occur on recently deposited materials in floodplains. Wetlands are riparian in nature but were treated separately because of their distinct ecological characteristics.

For this SEI, riparian ecosystems were classified into structural stages in order to identify different habitat values (Table 15).

Riparian ecosystems were also divided into distinct classes (bench, gully, fringe, river and beach) according to their environmental and vegetation characteristics; these are described below.

Riparian ecosystem* vs. *Riparian zone

'Riparian ecosystems' vary in width and are delineated by site-specific vegetation, soil, and topographic features. The term 'riparian zone' is often used to describe a fixed width management area surrounding streams and wetlands.

Bench riparian ecosystems

Bench riparian ecosystems are flood or ***fluvial*** ecosystems. They have distinct characteristics that are associated with moving water such as creeks, streams and rivers.

Bench riparian ecosystems are influenced by flooding, sediment deposition, erosion, and often, groundwater flows. Such sites include active floodplains, where seasonal flooding adds inputs of organic matter and fine soil materials, and river and stream terraces that are occasionally flooded. Bench riparian ecosystems are rich in nutrients and species. Generally, these sites are productive and develop more quickly after disturbance than

adjacent upland sites. Soils are saturated for only part of the growing season, but the moisture has a strong influence on plant composition[53].

Typically, these ecosystems occur as a band on either side of a creek and often form natural corridors through the landscape. Soils of this ecosystem type are typically sandy and gravely, and are poorly developed. These ecosystems have high vegetation structural diversity. They usually have a mix of coniferous and deciduous trees in the ***overstory***, with shrubby understories.

Shrub riparian ecosystems

Shrub riparian ecosystems are shrub dominated ecosystems that occur on floodplains or streams and rivers or along the edge of large lakes subject to extensive wave action. These ecosystems usually have moist sandy soils and are dominated by water birch and red-osier dogwood.

Gully riparian ecosystems

Gully riparian ecosystems occur at the base and lower slopes of moderate to steep-sided linear sites (small valleys or ravines) with significant moisture. These ecosystems have either permanent or intermittent surface water flow, or significant subsurface flow, and are not usually subject to flooding. Gullies are also rich and productive sites that form natural corridors through the study area, providing habitat distinctly different from the surrounding landscape. These ecosystems usually have mixed coniferous and deciduous overstory with shrubby understories.

Table 15. Structural stages of riparian ecosystems

Code	Name	Definition
RI:1	Unvegetated or sparsely vegetated	Less than 10% cover of vegetation
RI:2	Herb	Herb dominated, shrub cover <20%, tree cover less than 10%
RI:3	Shrub/herb	Shrub cover 20% or greater, tree cover less than 10%
RI:4	Pole sapling	Trees are >10m tall and have 10% or greater cover, dense stands, generally 10-40 years old
RI:5	Young forest	Trees are >10m tall and have 10% or greater cover, dominated by young trees about 40-80 years old
RI:6	Mature forest	Trees are >10m tall and have 10% or greater cover, dominated by mature trees about 80-250 years old
RI:7	Older forest	Trees are >10m tall and have 10% or greater cover, many tree ages, many trees are 250 years or older

53 MacKenzie and Banner 1999

Example of a fringe riparian ecosystem. (Photo credit: Susan Latimer)

Table 16. Riparian ecosystem vegetation. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

	Bench	Shrub	Gully	Fringe	
Trees					
black cottonwood	***			**	*Populus balsamifera*
paper birch		*	*	*	*Betula papyrifera*
Douglas-fir			*	*	*Pseudotsuga menziesii*
trembling aspen			***	**	*Populus tremuloides*
hybrid white spruce				**	*Picea engelmannii x glauca*
Shrubs					
poison ivy	**	*			*Toxicodendron rydbergii*
red-osier dogwood	**	***	**	**	*Cornus stolonifera*
roses	**	**	*	**	*Rosa* spp.
common snowberry	**	*	**	*	*Symphoricarpos albus*
water birch		***			*Betula occidentalis*
saskatoon	*		**		*Amelanchier alnifolia*
Douglas maple	*		**	*	*Acer glabrum*
mountain alder	*		*	*	*Alnus incana*
black gooseberry	*		*	*	*Ribes lacustre*
willows	*	*		*	*Salix* spp.
Grasses					
Kentucky bluegrass	*				*Poa pratensis*
Forbs					
horsetails	*	*	*		*Equisetum* spp.
star-flowered false Solomon's-seal	*	*	*		*Maianthemum stellatum*
mountain sweet-cicely	*	*			*Osmorhiza berteroi*

Fringe riparian ecosystems

Lakes and ponds typically have fringe riparian ecosystems associated with their shorelines. Sandy, gravely soils are common in these ecosystems and soils are often gleyed or mottled. This class also includes sites on ***fluvial fans,*** and sites with significant seepage that are sensitive to soil and hydrological disturbances; soils are typically medium-textured on these sites. Within the study area, fringe riparian ecosystems are commonly associated with the lake foreshores, pond fringes, moist seepage slopes, and moist depressions. These ecosystems usually have mixed coniferous and deciduous overstories with shrubby understories.

River riparian ecosystems

These are river ecosystems that include the flowing water and unvegetated sandbars, gravel bars and banks of the river.

Beach riparian ecosystems

Beaches are the unvegetated sandy or gravely edges of lakes subject to the wave action of the lake water. They may have scattered plants. In the study area, beach ecosystems only occur in the South Okanagan.

Wildlife

Invertebrates: Water bodies and the associated riparian vegetation are extremely productive sites for a large variety of insects and other invertebrates.

Amphibians & Reptiles: Vegetated riparian ecosystems provide foraging habitat for many species of snakes, and are important as thermal shelter during hot summers. Amphibians may breed in these ecosystems, especially where surface water is retained throughout the spring. Sandy sites may be important egg-laying sites for turtles.

Birds: Mature deciduous trees offer cavities that are important shelter and nest sites for a large variety of cavity-nesting birds, including many woodpeckers, and some owls, ducks, and songbirds. Herons and eagles often nest in riparian areas with large trees or snags. Shrubby sites provide good nesting habitat for a wide variety of perching birds, and generally provide abundant prey for insect-eating birds.

Mammals: The dense and diverse structure of healthy riparian ecosystems, including cavities and coarse woody debris, provides cover to a wide array of mammals. Plentiful food and shelter is available for many small mammals, which in turn are prey for larger animals. Riparian areas provide cover and browse for deer and other ***ungulates***. These sites are often rich in insects, and provide important foraging habitats for many bat species; some bats will roost in riparian vegetation as well. Long, linear riparian ecosystems provide travel corridors for many animals.

Why are they important?

Ecological and socio-economic values of riparian ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **At-risk status**: B.C. Conservation Data Centre lists most riparian ecological communities as at-risk (Table 17), as well as numerous plant (Table 18) and wildlife species (Table 19).
- **High biodiversity**: Offering moist habitats in an otherwise arid landscape, riparian ecosystems support a disproportionately high number of species relative to the area they occupy on the land base. The lush vegetation, wide diversity of plants and invertebrate organisms, and structural complexity of these ecosystems provide important food and shelter to an enormous variety of wildlife species. Habitat features such as cavities and dense shrubby thickets are not readily available elsewhere, and attract a large number of breeding birds. Many of the species that use riparian ecosystems do not occur elsewhere in the landscape.
- **Fragility**: Riparian ecosystems are strongly influenced by adjacent water bodies and, thus, they are sensitive to disturbance, extreme drought and flood events and changes in hydrology. They are subject to degradation and alteration by invasive alien plants, pollution, and artificial stabilization. Livestock grazing can severely reduce the amount of understory vegetation, as well as the stability of stream banks.
- **Aquatic habitat protection and water quality**: Riparian vegetation supplies most of the organic matter (70-80% of the food energy needed by aquatic communities) in small- and medium-sized streams, and plays a large role in determining the composition of the aquatic invertebrate community. Riparian vegetation also provides a source of large organic debris (e.g. logs). This debris reduces stream velocity, and is important in creating and maintaining stream channels, aquatic habitats — including spawning habitats, and in controlling sediment deposition[54]. Riparian areas are important for trapping sediments and maintaining water quality. The root systems of riparian vegetation stabilize stream banks, thus reducing erosion and sediment inputs to the water.

  Riparian vegetation plays a key role in controlling water temperatures of small and medium-sized streams. Forest canopies can reduce incoming radiation by up to 85% in smaller streams. This function is extremely important because the amount of dissolved oxygen and the metabolic processes of many stream organisms are dependent on temperature. With increased water temperatures, many native trout species become more susceptible to disease and are out-competed by warmer-water species[55].

54 Voller 1998
55 Voller 1998

- **Wildlife corridors**: Linear riparian ecosystems associated with streams form natural wildlife corridors, often connecting various habitat types. For wildlife that require seasonal or elevational shifts in habitats, larger streams may provide riparian corridors from valley bottom to mid-elevation forests.
- **Flood protection and erosion reduction**: Like wetlands, riparian ecosystems reduce peak flows by slowing or storing runoff. Installation of dykes and rip-rap to prevent flooding reduces water storage capacity and increases water velocity and scouring. Dense root growth of vegetation in riparian ecosystems helps slow water flow and provides bank stability. Unvegetated banks are prone to erosion, undercutting, and slumping. Even within these ecosystems, dynamic channel changes can lead to tree fall and bank slumping. Preventing development nearby maintains riparian areas which can buffer these effects.
- **Social values**: Riparian areas provide drinking water, green space, and opportunities for education, bird watching, wildlife viewing, walking, and aesthetic enjoyment. Retaining riparian corridors can enhance and maintain property values and attract tourists seeking the natural beauty of the area.

Status

Riparian ecosystems occupied 5.4% (18,879 ha) of the study area, and have been reduced in area by 73% since 1800[56]. Only 5% of riparian ecosystems in the study area is in the old forest structural stage. Another 30% is mature forest and 29% young forest, indicating that many riparian ecosystems have been altered by human disturbance. Historically, riparian ecosystems would have been dominantly old and mature structural stages, with some earlier structural stages where flooding and changes in watercourses had occurred relatively recently. Unvegetated riparian structural stages corresponded to river riparian ecosystems and beach riparian ecosystems.

Preserving all riparian ecosystems should be a priority; however, retaining old structural stages should be the highest priority. In all structural stages, it is important to retain all riparian vegetation to provide stream bank stability, maintain water temperature and quality, and maintain wildlife habitat values.

56 Lea 2007

Table 17. At-risk ecological communities of riparian ecosystems

Common Name	Scientific Name	Provincial Status
Water birch / roses	*Betula occidentalis / Rosa* spp.	Red
Hybrid white spruce / black gooseberry	*Picea engelmannii x glauca / Ribes lacustre*	Blue
Ponderosa pine - black cottonwood / poison ivy	*Pinus ponderosa - Populus balsamifera* ssp. *trichocarpa / Toxicodendron rydbergii*	Red
Ponderosa pine / smooth sumac	*Pinus ponderosa / Rhus glabra*	Red
Black cottonwood - water birch	*Populus balsamifera ssp. trichocarpa - Betula occidentalis*	Red
Black cottonwood - Douglas-fir - common snowberry / red-osier dogwood	*Populus balsamifera* ssp. *trichocarpa - Pseudotsuga menziesii / Symphoricarpos albus - Cornus stolonifera*	Red
Trembling aspen / common snowberry / Kentucky bluegrass	*Populus tremuloides / Symphoricarpos albus / Poa pratensis*	Red
Douglas-fir / Douglas maple - red-osier dogwood	*Pseudotsuga menziesii / Acer glabrum - Cornus stolonifera*	Red
Douglas-fir - water birch / Douglas maple	*Pseudotsuga menziesii - Betula occidentalis / Acer glabrum*	Red
Douglas-fir / common snowberry - birch-leaved spirea	*Pseudotsuga menziesii / Symphoricarpos albus - Spiraea betulifolia*	Blue
Douglas-fir / common snowberry / pinegrass	*Pseudotsuga menziesii / Symphoricarpos albus / Calamagrostis rubescens*	Blue

Rubber boa

Table 18. At-risk plants of riparian ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Scarlet Ammannia	*Ammannia robusta*	Endangered	Red
Short-rayed Aster	*Aster frondosus*	Endangered	Red
Mexican Mosquito Fern	*Azolla mexicana*	Threatened	Red
River Bulrush	*Bolboschoenus fluviatilis*		Red
Upswept Moonwort	*Botrychium ascendens*		Red
Short-flowered Evening-primrose	*Camissonia breviflora*		Red
Bigleaf sedge	*Carex amplifolia*		Blue
Bearded Sedge	*Carex comosa*		Red
Many-headed Sedge	*Carex sychnocephala*		Blue
Fox Sedge	*Carex vulpinoidea*		Blue
Western Centaury	*Centaurium exaltatum*		Red
Thyme-leaved Spurge	*Chamaesyce serpyllifolia* ssp. *serpyllifolia*		Blue
Atkinson's Coreopsis	*Coreopsis tinctoria* var. *atkinsoniana*		Red
Red-rooted Cyperus	*Cyperus erythrorhizos*		Red
Awned Cyperus	*Cyperus squarrosus*		Blue
Three-flowered Waterwort	*Elatine rubella*		Blue
Purple Spike-rush	*Eleocharis atropurpurea*	Endangered	Red
Beaked Spike-rush	*Eleocharis rostellata*		Blue
Giant Helleborine	*Epipactis gigantea*	Special Concern	Blue
False-mermaid	*Floerkea proserpinacoides*		Blue
Dwarf Groundsmoke	*Gayophytum humile*		Red
Orange Touch-me-not	*Impatiens aurella*		Blue
Colorado rush	*Juncus confusus*		Red
False Pimpernel	*Lindernia dubia* var. *anagallidea*		Blue
Small-flowered Lipocarpha	*Lipocarpha micrantha*	Endangered	Red
Hairy Water-clover	*Marsilea vestita*		Red
Oniongrass	*Melica bulbosa* var. *bulbosa*		Blue
Short-flowered monkey-flower	*Mimulus breviflorus*		Red
Brewer's monkey-flower	*Mimulus breweri*		Red
Close-flowered Knotweed	*Polygonum polygaloides* ssp. *confertiflorum*		Red
Kellogg's knotweed	*Polygonum polygaloides* ssp. *kelloggii*		Red
Bushy Cinquefoil	*Potentilla paradoxa*		Red
Alkaline Wing-nerved Moss	*Pterygoneurum kozlovii*		Red
Toothcup Meadow-foam	*Rotala ramosoir*	Endangered	Red
Peach-leaf Willow	*Salix amygdaloides*		Red
Olney's bulrush	*Schoenoplectus americanus*		Red
Rocky Mountain clubrush	*Schoenoplectus saximontanus*		Red
Prairie wedgegrass	*Sphenopholis obtusata*		Red
Hairgrass Dropseed	*Sporobolus airoides*		Red
Rough Dropseed	*Sporobolus compositus* var. *compositus*		Blue
Blunt-sepaled starwort	*Stellaria obtusa*		Blue
Cup clover	*Trifolium cyathiferum*		Red
Blue Vervain	*Verbena hastata* var. *scabra*		Red

Table 19. At-risk wildlife of riparian ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Monarch	*Danaus plexippus*	Special Concern	Blue
Emma's Dancer	*Argia emma*		Blue
Vivid Dancer	*Argia vivida*		Red
Olive Clubtail	*Stylurus olivaceus*		Red
Painted Turtle	*Chrysemys picta*	Special Concern	Blue
California Floater	*Anodonta californiensis*		Blue
Winged Floater	*Anodonta nuttalliana*		Blue
Attenuate Fossaria	*Fossaria truncatula*		Blue
Rocky Mountain Winged Mussel	*Gonidea angulata*	Special Concern	Red
Umbilicate Sprite	*Promenetus umbilicatellus*		Blue
Abbreviate Pondsnail	*Stagnicola apicina*		Blue
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue
Rubber Boa	*Chorina bottae*	Special Concern	Yellow
Gopher Snake	*Pituophis catenifer*	Threatened	Blue
Great Blue Heron	*Ardea herodias herodias*		Blue
Western Screech-Owl	*Megascops kennicottii macfarlanei*	Endangered	Red
Lewis' Woodpecker	*Melanerpes lewis*	Special Concern	Red
Yellow-breasted Chat	*Icteria virens*	Endangered	Red
Townsend's Big-eared Bat	*Corynorhinus townsendii*		Blue
Western Red Bat	*Lasiurus blossevillii*		unknown
Fisher	*Martes pennanti*		Blue
Chiselmouth	*Acrocheilus alutaceus*		Blue
Umatilla Dace	*Rhinichthys umatilla*	Special Concern	Red
Mountain Sucker	*Catostomus platrhynchus*		Blue
Chinook Salmon (Okanagan)	*Oncorhynchus tshawytscha*	Threatened	unknown
Columbia Sculpin	*Cottus hubbsi*	Special Concern	Blue

8 Old Forest

What are old forest ecosystems?

Old forest ecosystems are dominated by large, old trees typically greater than 150 years of age. Historically, old forests occupied a large proportion of the landscape, forming a matrix with other ecosystem types. Throughout the study area, harvesting of large, old trees has greatly reduced the area of old forest ecosystems. For the SEI, old forests were mapped where polygons included old structural stage ecosystems (structural stage 7) except for old riparian forests, which were included in the Riparian category.

In the past, most low-elevation forests (PP and IDF biogeoclimatic zones) had frequent surface fires that destroyed regeneration and allowed few trees into the overstory. Overstories were generally open and structurally complex, and understories were open and dominated by grasses and shrubs. Frequent fire limited the occurrence of dead wood to scattered large snags and large, downed wood. The exclusion of frequent fires[57] has transformed open, park-like forests to forests with dense canopies of Douglas-fir and ponderosa pine with understories dominated by dense tree regeneration. Fire exclusion has significantly altered the ecological communities and wildlife habitat supported by old forest communities. At present, many stands are at-risk from catastrophic wildfire due to fuel build-up.

At higher elevations, fire was and is less frequent and old forests have a multi-layered canopy with gaps and abundant downed wood. High elevation old forests are limited in occurrence due to logging. The complex stand structure of these high elevation old forests provides valuable wildlife habitat and should be retained.

57 Fire exclusion began in the mid-1800's with intensive livestock grazing that removed the fine grass fuels needed to carry fires. Later, traditional burning by aboriginal peoples was outlawed, and finally, fire suppression was implemented in the mid 1900's.

Table 20. Old Forest ecosystem vegetation. This vegetation table is based on mid- to low-elevation forests. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Trees		
Douglas-fir	***	*Pseudotsuga menziesii*
ponderosa pine	**	*Pinus ponderosa*
western larch	**	*Larix occidentalis*
Shrubs		
birch-leaved spirea	**	*Spirea betulifolia*
saskatoon	**	*Amelanchier alnifolia*
Grasses		
pinegrass	***	*Calamagrostis rubescens*
bluebunch wheatgrass	**	*Pseudoroegneria spicata*
junegrass	**	*Koeleria macrantha*
Forbs		
kinnikinnick	**	*Arctostaphylos uva-ursi*
heart-leaved arnica	**	*Arnica cordifolia*
dwarf blueberry	**	*Vaccinium caespitosum*

Wildlife

Amphibians & Reptiles: Salamanders, frogs and toads, lizards, and several snake species can be found in old forests. Rare species of these wildlife groups rely on low elevation old forests, particularly open ponderosa pine forests.

Birds: Old forests offer more nesting opportunity than younger forests to many forest-dwelling birds. Multi-layered stands have more structural complexity and forage availability from foliage and invertebrates. Many species, particularly woodpeckers and owls, rely on the large trees and snags that old forests contain, and the cavities they provide. In drier forests at low elevations, the open woodland conditions support numerous birds that forage for seeds or invertebrates on the trees or in the open understory. Open stands without significant ingrowth are extremely important to a couple of rare woodpeckers. Even stands with thickets of ingrowth are valuable for some birds, including owls.

Mammals: The structural complexity of old forests increases the availability of food and shelter to numerous mammals. Many small mammals, fur-bearers, and bats depend on features such as tree cavities, downed logs, or loose bark for cover. In moist areas, the closed canopies and open understories of older forests provide essential thermal and snow-interception cover in winter to many species, including deer and bighorn sheep, particularly if they are on warm aspects. Gaps in the canopy allow sunlight to penetrate in patches, and the resulting shrubby understories are important foraging habitat for herbivores. In old coniferous woodland without significant ingrowth, the open forest can provide habitat to some grassland species.

Why are they important?

Ecological and socio-economic values of old forest ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **At-risk status**: Most old forest ecological communities are listed as at-risk by the B.C. Conservation Data Centre (Table 21), as are many of the at-risk plant (Table 22) and wildlife species that rely on that habitat (Tables 23 and 24). Many species that depend on grassland ecosystems will also use open old coniferous forests. See the grassland species list as well.
- **High biodiversity:** Old forests are usually structurally complex, and provide habitat for a wide variety of wildlife, plant, and invertebrate species. They have many unique and important specialized habitats that are critical to numerous rare wildlife species. In addition to the high biodiversity within an old forest, the varying conditions (moisture, elevation) of old forest ecosystems increase the diversity of wildlife they support.
- **Specialized habitats:** Many species depend on features found only in old forests. The large, old trees and snags in these forests provide cavities, large branches, large slabs of loose bark, and large downed logs as cover and nesting sites for many reptiles, birds and mammals. Large old trees also provide good snow interception in winter, enabling mammals to travel and forage more easily in the understory, and multi-layered stands provide thermal cover and important winter forage to all sorts of animals.
- **Social values:** Old forests provide opportunities for education, wildlife viewing, hiking, and aesthetic enjoyment. The green space that old forests provide can add to real estate values and can act as a tourist draw.

Status

Historically, old forests likely dominated the majority of the low-elevation forested landscape, as old trees were retained by frequent low- to moderate-severity surface fires. Old trees were also a large component of ecosystems at higher elevations. Currently only small remnants of old forests exist. Most old forests have been lost to logging or forest ingrowth due to fire exclusion. The inventory showed that only 4.7% (16,194 ha) of the study area was old forests; these occurred in small and fragmented patches across the study area. These statistics show there is a need to conserve all remaining old forests. Large buffer areas of younger and mature forests around old forests are needed to provide recruitment and maintain ecological integrity for existing old forests.

Table 21. At-risk ecological communities of old forests

Common Name	Scientific Name	Provincial Status
Douglas-fir / common snowberry / pinegrass	*Pseudotsuga menziesii / Symphoricarpos albus / Calamagrostis rubescens*	Red
Douglas-fir - ponderosa pine / bluebunch wheatgrass	*Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata*	Red
Douglas-fir / common snowberry - birch-leaved spirea	*Pseudotsuga menziesii / Symphoricarpos albus - Spiraea betulifolia*	Red
Douglas-fir / pinegrass - kinnikinnick	*Pseudotsuga menziesii / Calamagrostis rubescens - Arctostaphylos uva-ursi*	Blue
Douglas-fir / pinegrass - twinflower	*Pseudotsuga menziesii / Calamagrostis rubescens - Linnaea borealis*	Blue
Douglas-fir - ponderosa pine / bluebunch wheatgrass - pinegrass	*Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata - Calamagrostis rubescens*	Blue
Douglas-fir - ponderosa pine / Idaho fescue	*Pseudotsuga menziesii - Pinus ponderosa / Festuca idahoensis*	Blue
Douglas-fir - ponderosa pine / pinegrass	*Pseudotsuga menziesii - Pinus ponderosa / Calamagrostis rubescens*	Blue
Douglas-fir - ponderosa pine / snowbrush	*Pseudotsuga menziesii - Pinus ponderosa / Ceanothus velutinus*	Blue
Douglas-fir / shrubby penstemon - pinegrass	*Pseudotsuga menziesii / Penstemon fruticosus - Calamagrostis rubescens*	Blue
Douglas-fir - western larch / pinegrass	*Pseudotsuga menziesii - Larix occidentalis / Calamagrostis rubescens*	Blue
Ponderosa pine / bluebunch wheatgrass - Idaho fescue	*Pinus ponderosa / Pseudoroegneria spicata - Festuca idahoensis*	Blue
Ponderosa pine / bluebunch wheatgrass - rough fescue	*Pinus ponderosa / Pseudoroegneria spicata - Festuca campestris*	Blue
Ponderosa pine / red three-awn	*Pinus ponderosa / Aristida purpurea* var. *longiseta*	Blue
Subalpine fir / white-flowered rhododendron / sitka valerian	*Abies lasiocarpa / Rhododendron albiflorum / Valeriana sitchensis*	Blue

Leiberg's Fleabane (Photo credit: Jenifer Penny)

Table 22. At-risk plants of old forest ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Nettle-leaved Giant-hyssop	*Agastache urticifolia*		Blue
Lyall's Mariposa Lily	*Calochortus lyallii*	Threatened	Red
Slender Hawksbeard	*Crepis atribarba* ssp. *atribarba*		Red
Smooth Willowherb	*Epilobium glaberrimum* ssp. *fastigiatum*		Blue
Leiberg's Fleabane	*Erigeron leibergii*		Red
Hairstem Groundsmoke	*Gayophytum ramosissimum*		Red
Prairie Gentain	*Gentiana affinis*		Blue
Porcupinegrass	*Hesperostipa spartea*		Red
Oniongrass	*Melica bulbosa* var. *bulbosa*		Blue
Showy Phlox	*Phlox speciosa* ssp. *occidentalis*	Threatened	Red

Table 23. At-risk wildlife of closed old forests

Common Name	Scientific Name	Federal Status	Provincial Status
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue
Flammulated Owl	*Otus flammeolus*	Special Concern	Blue
Williamson's Sapsucker.	*Sphyrapicus thyroideus thyroideus*	Endangered	Red
Olive-sided Flycatcher	*Contopus sooperi*	Threatened	Yellow
Bighorn Sheep	*Ovis canadensis*		Blue
Fisher	*Martes pennanti*		Blue
Wolverine	*Gulo gulo luscus*	Special Concern	Blue

Table 24. At-risk wildlife of open old forests

Common Name	Scientific Name	Federal Status	Provincial Status
Rubber Boa	*Charina bottae*	Special Concern	-
Gopher Snake	*Pituophis catenifer deserticola*	Threatened	Blue
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue
Swainson's Hawk	*Buteo swainsoni*		Red
Flammulated Owl	*Otus flammeolus*	Special Concern	Blue
Common Nighthawk	*Chordeiles minor*	Threatened	-
Lewis' Woodpecker	*Melanerpes lewis*	Special Concern	Red
White-headed Woodpecker	*Picoides albolarvatus*	Endangered	Red
Badger	*Taxidea taxus*	Endangered	Red

9 Antelope-brush Steppe

What are antelope-brush steppe ecosystems?

Antelope-brush steppe communities are dryland ecosystems characterized by abundant antelope-brush shrub cover. These communities occur in the southern portion of the Okanagan Valley, typically on sandy soils derived from glacial meltwaters, sometimes over-topped with a layer of ***aeolian*** material, in the warm, dry valley bottom. Since glaciers did not push far south into the Great Basin of Washington State, these ecosystems have a very limited extent. Antelope-brush steppe ecosystems are also dominated by bunchgrasses, with scattered ***forbs***, and a microbiotic crust on the soil surface dominated by selaginella, mosses and lichens.

For this SEI, antelope-brush steppe ecosystems were divided into two classes according to their vegetation characteristics and disturbance history: antelope-brush steppe and disturbed antelope-brush steppe.

Antelope-brush steppe ecosystems

Healthy antelope-brush steppe ecosystems are dominated by antelope-brush and bunchgrasses, including red three-awn grass, needle-and-thread grass, and bluebunch wheatgrass, along with a variety of forbs such as brittle prickly-pear cactus, selaginella, and bitterroot. Bunchgrasses have extensive fine roots to capture moisture in the upper horizons of the soil and are able to survive long periods of drought; antelope-brush has a deep taproot to capture deep moisture. Many antelope-brush steppe ecosystems have some human-related disturbance associated with them and have from 0-60% of their herbaceous vegetation

comprised of alien plants. Soils are usually sandy or gravely and are topped by a slightly darker-coloured horizon enriched by organic matter from the decomposition of grass roots.

Disturbed antelope-brush steppe ecosystems

Disturbed antelope-brush steppe ecosystems are dominated by antelope-brush together with alien plants (>60% of grasses and forbs) but have some native bunchgrasses and forbs and retain many of the values associated with antelope-brush steppe ecosystems.

Table 25. Antelope-brush steppe ecosystem vegetation. Species denoted by an [x] indicates an alien species. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

	Antelope-brush steppe	Disturbed Antelope-brush steppe	
Shrubs			
antelope-brush	***	***	*Purshia tridentata*
big sagebrush	**	**	*Artemisia tridentata*
common rabbit-brush	*	**	*Ericameria nauseosus*
Grasses			
bluebunch wheatgrass	**		*Pseudoroegneria spicata*
red three-awn	**	*	*Aristida purpurea*
needle-and-thread grass	**	**	*Hesperostipa comata*
sand dropseed	**	**	*Sporobolus cryptandrus*
Sandberg's bluegrass	**	*	*Poa secunda*
cheatgrass [x]	**	***	*Bromus tectorum*
Forbs			
compact selaginella	**	*	*Selaginella densa*
arrowleaf balsamroot	**	**	*Balsamorhiza sagittata*
brittle prickly-pear cactus	**	**	*Opuntia fragilis*
snow buckwheat	*	*	*Eriogonum niveum*
long-leaved phlox	*	*	*Phlox longifolia*
shaggy fleabane	*		*Erigeron pumilus*
woolly plantain	*	**	*Plantago patagonica*
diffuse knapweed [x]	*	**	*Centaurea diffusa*
Mosses and Lichens			
sidewalk moss	**	**	*Tortula ruralis*
clad lichens	**		*Cladonia* spp.

Wildlife

Invertebrates: Antelope-brush shrubs host a variety of insects, and are an essential food source for some rare butterflies. A wide array of other invertebrates, from scorpions and ticks to beetles and flies, occur in these ecosystems, including a number that are found nowhere else in Canada but their status is yet to be assessed.

Amphibians & Reptiles: The deep, sandy soils of these ecosystems provide excellent terrestrial habitats for desert-adapted amphibians, including rare salamanders and frogs that require loose soils for burrowing to avoid dehydration in summer and freezing in winter. Turtles lay their eggs in the sandy soils, as will some species of snakes if rodent burrows are present.

Birds: Many general grassland and shrub-nesting birds will use antelope-brush ecosystems, in addition to species that specifically prefer nesting in antelope-brush. Sagebrush-dependant species may also nest here when this shrub is present in high densities. These shrub-steppe ecosystems are important to many birds that prefer open habitats for foraging, including birds of prey such as hawks and falcons.

Mammals: These ecosystems host a variety of small mammals, including some rare species of shrews, mice, and rabbits. Some rodents are dependant on the seeds of the antelope-brush shrub for food. Larger burrowing mammals such as badgers may use these areas for foraging, but the sandy soils often will not support their dens or those of some main prey species, including pocket gophers and marmots.

Why are they important?

Ecological and socio-economic values of antelope-brush steppe ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **At-risk status:** The only antelope-brush ecological community occurring in Canada is restricted to the south Okanagan, and is listed by the B.C. Conservation Data Centre (Table 26). Many at-risk plant (Table 27) and wildlife species (Table 28) are reliant on this globally-imperilled ecosystem. Due to fire history, antelope-brush steppe ecosystems that have been recently burned may have low covers of antelope-brush and therefore may contain habitat characteristics of grassland or sagebrush-steppe ecosystems, in which case, those species lists should be consulted as well.
- **Highly threatened:** Antelope-brush steppe ecosystems most commonly occur on sites that are very amenable to development — primarily for vineyards and housing. Overuse by domestic livestock and the introduction and spread of invasive plants also threatens remaining antelope-brush steppe ecosystems. Antelope-brush steppe ecosystems are recognised as one the four most endangered ecosystems in Canada.

- **High biodiversity**: Antelope-brush steppe ecosystems support a vast array of plants and animals, including many general grassland and shrub-steppe species, as well as a unique and specialized assemblage of wildlife dependant on antelope-brush steppe habitats. A high proportion of rare species, including invertebrates, amphibians, reptiles, birds and mammals, rely on these habitats, and are well adapted to the conditions found in these ecosystems.
- **Sensitivity to disturbance**: Antelope-brush steppe ecosystems have very fragile soils that are vulnerable to recreation and other disturbances, and recovery can take many decades. Disturbing soils can damage the fragile microbiotic crust and can allow or advance the spread of invasive alien plants. Antelope-brush steppe ecosystems that have been invaded by cheatgrass are susceptible to more intense fires than would have occurred historically. Antelope-brush cannot re-sprout after fire and must re-colonize by seed.
- **Social values**: Antelope-brush steppe ecosystems provide opportunities for education, walking, wildlife viewing, and aesthetic enjoyment. The green space that they provide can add to real estate values in adjacent areas. Because of the unique flora and fauna of antelope-brush steppe ecosystems, birders and other naturalists are commonly attracted to these areas.

Status

Antelope-brush steppe ecosystem covered 9895 ha and 7325 ha in 1800 and 1938, respectively[58]. In 2005, mapping indicated that antelope-brush steppe ecosystems covered 0.9% (3171 hectares) of the study area. Since 1800 there has been approximately a 73% loss of this ecosystem[59]. Antelope-brush steppe ecosystems with more than 60% alien vegetation were included in the disturbed antelope-brush steppe subclass. Most of the less-disturbed antelope-brush steppe ecosystems were restricted to steeper slopes or areas with poor access for people and domestic livestock.

All antelope-brush steppe ecosystems are a very high priority for conservation considering that most have already been lost to agricultural and urban development, and many sites had been invaded by alien plants.

Racer

Pale evening-primrose (Photo credit: Jenifer Penny)

58 Lea 2007
59 Lea 2007

Table 26. At-risk ecological communities of antelope-brush steppe

Common Name	Scientific Name	Provincial Status
Antelope-brush / needle-and-thread grass	*Purshia tridentata / Hesperostipa comata*	Red

Table 27. At-risk plants of antelope brush ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
The Dalles Milk-Vetch	*Astragalus sclerocarpus*		Red
Cockscomb Cryptantha	*Cryptantha celosioides*		Red
Field Dodder	*Cuscuta campestris*		Blue
Cushion Fleabane	*Erigeron poliospermus* var. *poliospermus*		Blue
Shy Gilia	*Gilia sinuata*		Red
Prairie Pepper-grass	*Lepidium densiflorum* var. *pubicarpum*		Red
Pale Evening-Primrose	*Oenothera pallida* ssp. *pallida*		Red
Scarlet Globe-mallow	*Sphaeralcea coccinea*		Red
Munroe's Globe-mallow	*Sphaeralcea munroana*		Red

Table 28. At-risk wildlife of antelope-brush steppe ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Immaculate Green Hairstreak	*Callophrys affinis*		Blue
Behr's Hairstreak	*Satyrium behrii*	Threatened	Red
California Hairstreak	*Satyrium californica*		Blue
Great Basin Spadefoot	*Spea intermontana*	Threatened	Blue
Tiger Salamander	*Ambystoma tigrinum*	Endangered	Red
Pigmy Short-horned Lizard	*Phrynosoma douglasii*	Extirpated	Red
Racer	*Coluber constrictor*	Special Concern	Blue
Night Snake	*Hypsiglena torquata*	Endangered	Red
Gopher Snake	*Pituophis catenifer deserticola*	Threatened	Blue
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue
Ferruginous Hawk	*Buteo regalis*	Special Concern	-
Prairie Falcon	*Falco mexicanus*		Red
Peregrine Falcon	*Falco peregrinus anatum*	Special Concern	Red
Common Nighthawk	*Chordeiles minor*	Threatened	-
Lewis' Woodpecker	*Melanerpes lewis*	Special Concern	Red
Lark Sparrow	*Chondestes grammacus*		
Merriam's Shrew	*Sorex merriami*		Red
Preble's Shrew	*Sorex preblei*		Red
Pallid Bat	*Antrozous pallidus*	Threatened	Red
Western Small-footed Myotis	*Myotis ciliolabrum*		Blue
Fringed Myotis	*Myotis thysanodes*		Blue
California Bighorn Sheep	*Ovis canadensis*		Blue
Great Basin Pocket Mouse	*Perognathus parvus*		Red
Western Harvest Mouse	*Reithrodontomys megalotis*	Special Concern	Blue
White-tailed Jackrabbit	*Lepus townsendii*		Red
Nuttall's Cottontail	*Sylvilagus nuttallii*	Special Concern	Blue

10 Grasslands & Disturbed Grasslands

What are grassland ecosystems?

Grasslands are dominated by bunchgrasses and scattered forbs, and also include areas of shrubland dominated by snowberry and rose. Disturbed grasslands are dominated by invasive plants, bunchgrasses and native forbs. The grasslands of the Okanagan represent a portion of the Pacific Northwest bunchgrass grassland ecosystems that are centred in central and northern Washington, north-east Oregon and Idaho[60].

Areas where grasslands occur are generally too hot and dry for forests to establish. Grasslands occur on medium and finer textured soils (typically ***chernozems***). Moisture is effectively funnelled by the conical shape of bunchgrasses and captured by extensive grass roots in the upper horizons of the soil, leaving little moisture available for tree seedlings. Shrublands tend to occur on slightly moister and richer patches within a grassland landscape. In comparison, trees are usually able to establish on moister sites, and on coarse soils (sandy, gravely) where moisture is available at depth. Additionally, grasslands are favoured in environments where frequent, low-severity fires historically occurred.

Grassland ecosystems were divided into distinct classes according to their environmental and vegetation characteristics; these subclasses were treated differently in different project areas as described below.

In the South Okanagan, City of Kelowna, and the Coldstream-Vernon SEIs, disturbed grasslands are considered a subclass of the Grasslands SEI category. In the Central Okanagan, Bella Vista-Goose Lake Range, District of Lake Country, and Vernon Commonage SEIs, disturbed grasslands are a separate class of Other

What is a bunchgrass?
Bunchgrasses are grasses where several stems grow in a close tuft forming a characteristic growth habit of forming a bunch. Common bunchgrasses in the study area:
bluebunch wheatgrass *(Pseudoroegneria spicata)*
Idaho fescue *(Festuca idahoensis)*
junegrass *(Koeleria macrantha)*
rough fescue *(Festuca campestris).*

Much of the diversity within grasslands is found in the microbiotic crust that covers the soil surface between plants. The microbiotic crust is composed of lichens, mosses, algae, bacteria and cyanobacteria. Crusts slow evaporation, prevent wind and water erosion, and contribute nutrients through nitrogen fixation. The microbiotic crust is extremely sensitive to disturbance by livestock and people.[61]

60 Tisdale 1947
61 Williston 1999

Important Ecosystem. They should now be considered as a Sensitive Ecosystem category.

In the Bella Vista-Goose Lake Range, Vernon Commonage, and Lake Country SEIs, areas with sagebrush appeared to be a result of disturbance and these ecosystems were also mapped as part of the disturbed grassland class.

Steep grasslands and steep, shallow-soil grassland ecosystems were only mapped in the South Okanagan SEI; they are included as part of the grassland subclass for all other projects.

Table 29. Grassland ecosystem vegetation. Species denoted by an [x] indicates an alien species. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

	Grasslands	Steep Grasslands	Steep, Shallow Grasslands	Disturbed Grasslands	Shrublands	
Shrubs						
big sagebrush	**	**	**	**		*Artemisia tridentata*
common snowberry					***	*Symphoricarpos albus*
roses					**	*Rosa* spp.
Grasses						
bluebunch wheatgrass	***	***	***	**		*Pseudoroegneria spicata*
Idaho fescue	**	**		*		*Festuca idahoensis*
junegrass	**	**	**			*Koeleria macrantha*
Sandberg's bluegrass	**	**	*	**		*Poa secunda*
needle-and-thread grass	*	*	*	**		*Hesperostipa comata*
sand dropseed	*	*		**		*Sporobolus cryptandrus*
cheatgrass [x]	*	*	*	***		*Bromus tectorum*
Forbs						
arrowleaf balsamroot	**	**	**	**		*Balsamorhiza sagittata*
daisies or fleabanes	**	**	*	**		*Erigeron* spp.
desert-parsley	**	**	*	**		*Lomatium* spp.
pussytoes	**	*	*	**		*Antennaria* spp.
silky lupine	*	**	*	*		*Lupinus sericeus*
diffuse knapweed [x]	*	*		**		*Centaurea diffusa*
western groundsel					**	*Senecio integerrimus*
Mosses and Lichens						
sidewalk moss	**	**	**	*		*Tortula ruralis*
clad lichens	**	**	**	*		*Cladonia* spp.

Grassland ecosystems

Bunchgrasses, including bluebunch wheatgrass and Idaho fescue, and rough fescue in the north, and a variety of forbs dominate healthy grassland ecosystems in the study area. Some grasslands have scattered shrubs such as big sagebrush or rabbit brush; generally there is less than 10% cover of shrubs. Many grasslands have some disturbance associated with them and have from 0-60% of their vegetation comprised of alien plants. Grassland soils are usually fine- or medium-textured, and soils are topped by a thick, dark-coloured horizon enriched by organic matter from the decomposition of grass roots. Grasslands occur on soils that are 20cm to more than 1m deep, and in the South Okanagan, on slopes less than 25%.

"More than 30% of the province's species at-risk live in the southern interior grassland habitats."
Grassland Conservation Council of BC 2007

Steep grassland ecosystems

Steep grasslands are similar to grassland ecosystems except they occur on slopes greater than 25%. Often these sites have fewer alien plants because they are less likely to be disturbed by humans and domestic cattle. Soils are greater than 1m deep.

Steep, shallow-soil grassland ecosystems

Steep, shallow-soil grasslands are similar to grassland ecosystems except that they occur on slopes greater than 25% and have soils that are 20cm to 1m deep. Their shallow soils make them even more sensitive to soil disturbances. Often these sites have fewer alien plants because they are less likely to be disturbed by humans and domestic cattle.

Many of the forbs that grow in grasslands, including arrowleaf balsamroot (Balsamorhiza sagittata), bitterroot (Lewisia rediviva), and mariposa lily (Calochortus spp.) were important food sources for aboriginal peoples.

Disturbed grassland ecosystems

Disturbed grassland ecosystems are dominated by alien plants (>60%) but have some native bunchgrasses and forbs and retain many of the values associated with grassland ecosystems. Their soils are similar to grassland ecosystems and they occur on all slopes.

Shrubland ecosystems

Shrubs, most commonly snowberry and rose, dominate shrubland ecosystems in the study area. Shrublands occur in grassland areas, but are moister than the surrounding grasslands as they occur in depressions and moist pockets that tend to collect snow and run-off. Soils are dark (organic rich), typically medium-textured and very rich.

Wildlife

Invertebrates: Grasslands host a huge variety of insects and arachnids, including several species of rare butterflies. A wide array of rare invertebrates occur in these ecosystems, including a number that are found nowhere else in Canada but their official status is yet to be assessed.

Amphibians & Reptiles: Desert-adapted amphibians rely on deep-soiled grasslands for terrestrial habitats, including foraging and overwintering. The soils of these ecosystems are conducive to supporting rodent burrows, which provide cover to rare salamanders and snakes. Some snakes are particularly attracted to these areas for foraging on subterranean rodents, and will lay their eggs in burrows occurring on warm aspects. At least one species of rare lizard forages in grasslands, and another may be extirpated. Bedrock features in shallow-soiled grasslands can provide denning opportunities to some snakes and lizards.

Birds: A large number of birds require the openness of grasslands, and the visibility it offers to both predators and prey. Many species of hawks and falcons, including several rare species, forage over grasslands. Ground-nesting grassland birds often need certain conditions, from lush grasslands with large bunchgrass tufts to tuck the nest into, to very large and flat areas with short vegetation.

Mammals: Numerous mammals occur in grasslands, and many are specialized to these ecosystems, including rare bats, shrews, rodents, rabbits, badgers, and California bighorn sheep. Many species of bats forage over grasslands for flying insects, and some for ground invertebrates like beetles and scorpions. Deep-soiled grasslands provide excellent burrowing opportunities for badgers and small mammals, including several rare species. The rodent burrows may then provide cover to other wildlife, and the occupant may become prey.

Bluebunch wheatgrass-arrowleaf balsamroot ecological community

Why are they important?

Ecological and socio-economic values of grassland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **At-risk status:** All grassland ecological communities in the Okanagan Valley are listed as at-risk by the B.C. Conservation Data Centre (Table 30), as are many of the plant (Table 31) and wildlife species (Table 32) they support.
- **Highly threatened:** Grasslands most commonly occur on sites that are very amenable to development, both for agriculture and housing. Overuse by domestic livestock and the introduction and spread of invasive plants also threatens remaining grasslands. Only 0.69% of the world's temperate grasslands are currently protected[62]. Grasslands are recognized as one of British Columbia's most threatened ecosystems[63], covering less than 1% of the provincial landbase, with only 8% of provincial grasslands protected[64].
- **High biodiversity:** Grasslands support a unique assemblage of species that includes a high proportion of at-risk species. While grasslands may appear simple or barren, many of the species occurring in grasslands are easily overlooked, from the organisms comprising the microbiotic crust, annual wildflowers that wither by summer, and diverse invertebrates, to the amphibians, reptiles, birds and mammals that are often well-camouflaged or in underground burrows during the day.
- **Sensitivity to disturbance:** Grasslands are very sensitive to disturbances from such activities as off-road vehicle use and mountain biking. Recovery can take many decades. Disturbance to grassland soils can damage the fragile microbiotic crust and can allow the introduction and spread of invasive plants. Poorly managed grazing of domestic livestock can reduce or eliminate the cover of many native plant species and greatly alter wildlife habitat values.
- **Social values**: Grasslands provide opportunities for education, walking, wildlife viewing, and aesthetic enjoyment. The green space that grasslands provide can add to real estate values in adjacent areas.

"Introduced plant species cover an average of 35% of grasslands."
Grassland Conservation Council of BC 2007

Status

At the time of current mapping, grassland ecosystems covered 10.8% (37,506 hectares) of the study area. Historical mapping estimates that there has been approximately 39% loss of grassland ecosystems since 1800[65]. Grasslands with more than 60% alien vegetation were included in the disturbed grasslands subclass or class. All grassland ecosystems are a high priority for conservation as many have been lost to agricultural and urban development, and many sites have been invaded by alien plants. Fire suppression has increased the threat to grassland ecosystems by increasing the encroachment of trees onto grasslands.

62 IUNC 1994
63 Canadian Parks and Wilderness Society 1996
64 Grasslands Conservation Council of B.C. 2002
65 Lea 2007

Table 30. At-risk ecological communities of grasslands

Common Name	Scientific Name	Provincial Status
Bluebunch wheatgrass - arrowleaf balsamroot	*Pseudoroegneria spicata - Balsamorhiza sagittata*	Red
Bluebunch wheatgrass - junegrass	*Pseudoroegneria spicata - Koeleria macrantha*	Red
Bluebunch wheatgrass - western pasqueflower	*Pseudoroegneria spicata - Anemone occidentalis*	Red
Idaho fescue - bluebunch wheatgrass	*Festuca idahoensis - Pseudoroegneria spicata*	Red
Rough fescue - bluebunch wheatgrass	*Festuca campestris - Pseudoroegneria spicata*	Red
Threetip sagebrush / bluebunch wheatgrass - arrowleaf balsamroot	*Artemisia tripartita / Pseudoroegneria spicata - Balsamorhiza sagittata*	Red

Table 31. At-risk plants of grassland ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Western Dogbane	*Apocynum x floribundum*		Blue
Threadstalk Milk-Vetch	*Astragalus lentiginosus*		Blue
The Dalles Milk-Vetch	*Astragalus sclerocarpus*		Red
Two-spiked Moonwort	*Botrychium paradoxum*		Red
Narrow-leaved Brickellia	*Brickellia oblongifolia* ssp. *oblongifolia*		Red
Columbia Carpet Moss	*Bryoerythrophyllum columbianum*	Special Concern	Blue
Andean Evening-primrose	*Camissonia andina*		Red
Annual Paintbrush	*Castilleja minor* spp. *minor*		Red
Slender Hawksbeard	*Crepis atribarba* ssp. *atribarba*		Red
Watson's Cryptantha	*Cryptantha watsonii*		Blue
Leiberg's Fleabane	*Erigeron leibergii*		Red
Dwarf Groundsmoke	*Gayophytum humile*		Red
Racemed Groundsmoke	*Gayophytum racemosum*		Red
Hairstem Groundsmoke	*Gayophytum ramosissimum*		Blue
Whited's Halimolobos	*Halimolobos whitedii*		Red
Heterocodon	*Heterocodon rariflorum*		Blue
Western Stickseed	*Lappula occidentalis* var. *cupulata*		Red
Northern Linanthus	*Linanthus septentrionalis*		Blue
Nugget Moss	*Microbryum vlassovii*	Endangered	Red
Oniongrass	*Melica bulbosa* var. *bulbosa*		Blue
Flat-topped Broomrape	*Orobanche corymbosa* ssp. *mutabilis*		Red
Grand Coulee Owl-clover	*Orthocarpus barbatus*	Endangered	Red
Winged Combseed	*Pectocarya penicillata*		Red
Showy Phlox	*Phlox speciosa* ssp. *occidentalis*	Threatened	Red
Scarlet Globe-mallow	*Sphaeralcea coccinea*		Red
Munroe's Globe-mallow	*Sphaeralcea munroana*		Red
Okanagan Fameflower	*Talinum sediforme*	Not at Risk	Blue

Table 32. At-risk wildlife of grasslands

Common Name	Scientific Name	Federal Status	Provincial Status
Immaculate Green Hairstreak	*Callophrys affinis*		Blue
Sandhill Skipper	*Polites sabuleti*		Red
Sonora Skipper	*Polites sonora*	Special Concern	Red
Checkered Skipper	*Pyrgus communis*		Blue
California Hairstreak	*Satyrium californica*		Blue
Great Basin Spadefoot	*Spea intermontana*	Threatened	Blue
Tiger Salamander	*Ambystoma tigrinum*	Endangered	Red
Western Skink	*Eumeces skiltonianus*	Special Concern	Blue
Pigmy Short-horned Lizard	*Phrynosoma douglasii*	Extirpated	Red
Silky Vallonia	*Vallonia cyclophorella*		Blue
Racer	*Coluber constrictor*	Special Concern	Blue
Night Snake	*Hypsiglena torquata*	Endangered	Red
Gopher Snake	*Pituophis catenifer deserticola*	Threatened	Blue
Swainson's Hawk	*Buteo swainsoni*		Red
Ferruginous Hawk	*Buteo regalis*	Special Concern	-
Prairie Falcon	*Falco mexicanus*		Red
Peregrine Falcon	*Falco peregrinus anatum*	Special Concern	Red
Long-billed Curlew	*Numenius americanus*	Special Concern	Blue
Short-eared Owl	*Asio flammeus*	Special Concern	Blue
Burrowing Owl	*Athene cunicularia*	Endangered	Red
Common Nighthawk	*Chordeiles minor*	Threatened	-
Lewis' Woodpecker	*Melanerpes lewis*	Special Concern	Red
Grasshopper Sparrow	*Ammodramus savannarum*		Red
Merriam's Shrew	*Sorex merriami*		Red
Preble's Shrew	*Sorex preblei*		Red
Pallid Bat	*Antrozous pallidus*	Threatened	Red
Western Small-footed Myotis	*Myotis ciliolabrum*		Blue
Fringed Myotis	*Myotis thysanodes*		Blue
Badger	*Taxidea taxus*	Endangered	Red
California Bighorn Sheep	*Ovis canadensis*		Blue
Great Basin Pocket Mouse	*Perognathus parvus*		Red
Western Harvest Mouse	*Reithrodontomys megalotis*	Special Concern	Blue
White-tailed Jackrabbit	*Lepus townsendii*		Red
Nuttall's Cottontail	*Sylvilagus nuttallii*	Special Concern	Blue

Arrow-leaved balsamroot (Photo credit: Calvin Tolkamp)

11 Sagebrush steppe

What are sagebrush steppe ecosystems?

Sagebrush steppe ecosystems are dryland ecosystems characterized by abundant big sagebrush. These communities occur on similar sites to grassland ecosystems, where conditions are too warm and dry for trees to establish. Sagebrush steppe ecosystems are also dominated by bunchgrasses, with scattered forbs, and a microbiotic crust dominated by mosses and lichens.

In the Bella Vista – Goose Lake Range, Vernon Commonage, and Lake Country SEIs, areas with sagebrush appeared to be a result of disturbance and these ecosystems were mapped as part of the disturbed grassland class.

Sagebrush steppe ecosystems were divided into four distinct classes according to their environmental and vegetation characteristics, and their disturbance history: sagebrush steppe; steep sagebrush steppe; steep, shallow soil sagebrush steppe; and disturbed sagebrush steppe.

Sagebrush steppe ecosystems

Healthy sagebrush-steppe ecosystems are dominated by big sagebrush and bunchgrasses, most commonly bluebunch wheatgrass and Idaho fescue, and a variety of forbs. In contrast to grasslands, shrub cover is greater than 10%. Many sagebrush steppe communities have some disturbance associated with them and 0-60% of their herbaceous plant cover is comprised of alien plants. Sagebrush steppe soils are usually fine- or medium-textured, and soils are topped by a thick, dark-coloured horizon enriched by organic matter from the decomposition of grass roots. Sagebrush steppe ecosystems occur on soils that are 20cm to more than 1m deep and on slopes less than 25%.

Steep sagebrush steppe ecosystems

Steep sagebrush steppe ecosystems are similar to sagebrush steppe ecosystems except that they occur on slopes greater than 25%. Often these ecosystems have fewer alien plants than sagebrush steppe ecosystems because livestock are less likely to graze steeper slopes. Soils are greater than 1m deep.

Steep, shallow-soil sagebrush steppe ecosystems

Steep, shallow-soil sagebrush steppe ecosystems are similar to sagebrush steppe ecosystems except that they occur on slopes greater than 25% and have soils that are 20 cm to 1 m deep. Their shallow soils make them even more sensitive to soil disturbances. Often these ecosystems have fewer alien plants than sagebrush steppe ecosystems because livestock are less likely to graze steeper slopes.

Disturbed sagebrush steppe ecosystems

The herbaceous plant cover of disturbed sagebrush steppe ecosystems is dominated by alien plants (>60%) but still has abundant big sagebrush and some native bunchgrasses and forbs. These communities retain many of the values associated with sagebrush steppe ecosystems. Their soils are similar to sagebrush steppe ecosystems and they occur on all slopes.

Table 33. Sagebrush steppe ecosystem vegetation. Species denoted by an [x] indicates an alien species. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

	Sagebrush steppe	Steep Sagebrush steppe	Steep, Shallow Sagebrush steppe	Disturbed Sagebrush steppe	
Shrubs					
big sagebrush	***	***	***	***	*Artemisia tridentate*
Grasses					
bluebunch wheatgrass	**	***	***	*	*Pseudoroegneria spicata*
needle-and-thread grass	**	*	*	*	*Hesperostipa comata*
Sandberg's bluegrass	**	*	*	*	*Poa secunda*
cheatgrass [x]	**	**	**	***	*Bromus tectorum*
Idaho fescue	*				*Festuca idahoensis*
Forbs					
arrowleaf balsamroot	**	*	*	**	*Balsamorhiza sagittata*
threetip sagebrush	**	*	*	*	*Artemisia tripartite*
buckwheat	**	*	*	*	*Eriogonum* spp.
brittle prickly-pear cactus	**	*	*	*	*Opuntia fragilis*
long-leaved phlox	**	**	**	**	*Phlox longifolia*
yarrow	*	*	*	**	*Achillea millefolium*
pussytoes	*	*	*	**	*Antennaria* spp.
daisies or fleabanes	*	*	*	*	*Erigeron* spp.
thread-leaved phacelia	*	*	*	*	*Phacelia linearis*
diffuse knapweed [x]				**	*Centaurea diffusa*
Mosses and Lichens					
sidewalk moss	**	**	**	**	*Tortula ruralis*
clad lichens	**	**	**	*	*Cladonia* spp.

Wildlife

Invertebrates: A wide variety of insects and other invertebrates occur in sagebrush ecosystems, including some rare butterflies that are only known from sagebrush habitat. Some species reliant on antelope-brush may use these habitats if those shrubs occur as well.

Amphibians & Reptiles: Sagebrush ecosystems offer many of the same burrowing and foraging opportunities to amphibians and reptiles as grasslands do, and the shrubs provide additional cover necessary for other snake species. Shallow-soiled sagebrush habitats on warm aspects may offer denning opportunities to some snakes and lizards.

Birds: Sagebrush habitats are important to a large variety of general grassland or shrub-steppe birds, and many other species are reliant on sagebrush in particular for nesting and foraging.

Mammals: Numerous grassland mammals also use sagebrush ecosystems, and some prefer the cover from predators that shrubs offer. Deep-soiled sagebrush-steppe has similar soils to comparable grassland ecosystems, and offer excellent burrowing opportunities for small mammals, including the extra cover of shrub root systems from digging predators. Shallow-soiled sagebrush habitats may provide cover to small mammals that den in rock features.

Why are they important?

Ecological and socio-economic values of sagebrush steppe ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **At-risk status:** All sagebrush steppe ecological communities are listed as at-risk by the B.C. Conservation Data Centre (Table 34), as are most of the plant (Table 35) and wildlife species (Table 36) that rely on them. Some grassland-dependant species may use sagebrush habitats if shrub density is fairly low, and some species that rely on antelope-brush will use them if that shrub is also present. Species lists for grassland and Antelope-brush steppe ecosystems should be consulted as well
- **Highly threatened:** Sagebrush steppe ecosystems commonly occur on sites that are amenable to urban or agricultural development. Overuse by livestock and invasive plants also threaten the remaining sagebrush steppe ecosystems.
- **High biodiversity:** Sagebrush steppe supports a unique assemblage of species that includes a high proportion of rare species. Sagebrush ecosystems are used by many species that require open grassland-type conditions, as well as many that are dependant specifically on sagebrush habitats.

- **Sensitivity to disturbance:** Sagebrush steppe ecosystems are very sensitive to disturbances from such things as off-road vehicle use and mountain biking, and recovery can take many decades. Disturbance to sagebrush steppe soils can damage the fragile microbiotic crust, and can allow the introduction and spread of invasive plants, which can slow or limit recovery.
- **Social values:** Sagebrush steppe ecosystems provide opportunities for education, walking and hiking, wildlife viewing, and aesthetic enjoyment. The green space that these ecosystems provide can add to real estate values in adjacent areas.

Status

This study found that sagebrush steppe ecosystems covered 2.5% (8535 hectares) of the study area. Historical mapping estimates that there has been approximately 33% ecosystem loss of sagebrush steppe communities since 1800[66]. Sagebrush steppe ecosystems with more than 60% alien vegetation were included in the disturbed sagebrush steppe subclass. Most of the less-disturbed sagebrush steppe ecosystems were restricted to steeper slopes or areas with poor access for people and livestock.

All sagebrush steppe ecosystems are a high priority for conservation considering that most have already been lost to agriculture and urban settlement and many sites have been invaded by alien plants.

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Table 34. At-risk ecological communities of sagebrush steppe

Common Name	Scientific Name	Provincial Status
Big sagebrush / bluebunch wheatgrass	*Artemisia tridentata / Pseudoroegneria spicata*	Red
Big sagebrush / bluebunch wheatgrass - arrowleaf balsamroot	*Artemisia tridentata / Pseudoroegneria spicata - Balsamorhiza sagittata*	Red
Vasey's big sagebrush / pinegrass	*Artemisia tridentata var. vaseyana / Calamagrostis rubescens*	Red

Table 35. At-risk plants of sagebrush steppe ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Nettle-leaved Giant-hyssop	*Agastache urticifolia*		Blue
Western Dogbane	*Apocynum x floribundum*		Blue
The Dalles Milk-Vetch	*Astragalus sclerocarpus*		Red
Silvery Orache	*Atriplex argentea* ssp. *argentea*		Red
Wedgescale Orache	*Atriplex truncata*		Red
Two-spiked Moonwort	*Botrrychium paradoxum*		Red
Blue grama	*Bouteloua gracilis*[67]		Red
Columbia Carpet Moss	*Bryoerythrophyllum columbianum*	Special Concern	Blue
Slender Hawksbeard	*Crepis atribarba* ssp. *atribarba*		Red
Cockscomb Cryptantha	*Cryptantha celosioides*		Red
Field dodder	*Cuscuta campestris*		Blue
Cushion Fleabane	*Erigeron poliospermus* var. *poliospermus*		Red
Strict buckwheat	*Eriogonum strictum* var. *proliferum*		Red
Scarlet Gaura	*Gaura coccinea*		Red
Dwarf Groundsmoke	*Gayophytum humile*		Red
Shy Gilia	*Gilia sinuata*		Red
Slender Gilia	*Gilia tenerrima*		Red
Whited's Halimolobos	*Halimolobos whitedii*		Red
Heterocodon	*Heterocodon rariflorum*		Blue
Western Stickseed	*Lappula occidentalis* var. *cupulata*		Red
Prairie pepper-grass	*Lepidium densiflorum* var. *pubicarpum*		Red
Northern Linanthus	*Linanthus septentrionalis*		Blue
Nugget Moss	*Microbryum vlassovii*	Endangered	Red
Wild Tobacco	*Nicotiana attenuata*		Red
Grand Coulee Owl-clover	*Orthocarpus barbatus*	Endangered	Red
Winged Combseed	*Pectocarya penicillata*		Red
Branched phacelia	*Phacelia ramosissima* var. *ramosissima*	Endangered	Red
Showy Phlox	*Phlox speciosa* ssp. *occidentalis*	Threatened	Red
Scarlet Globe-mallow	*Sphaeralcea coccinea*		Red
Munroe's Globe-mallow	*Sphaeralcea munroana*		Red
Hairgrass Dropseed	*Sporobolus airoides*		Red
Rough Dropseed	*Sporobolus compositus* var. *compositus*		Blue
Thick-leaved Thelypody	*Thelypodium laciniatum* var. *laciniatum*		Blue

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Table 36. At-risk wildlife of sagebrush-steppe

Common Name	Scientific Name	Federal Status	Provincial Status
Immaculate Green Hairstreak	*Callophrys affinis*		Blue
California Hairstreak	*Satyrium californica*		Blue
Half-moon Hairstreak	*Satyrium semiluna*	Endangered	Red
Great Basin Spadefoot	*Spea intermontana*	Threatened	Blue
Tiger Salamander	*Ambystoma tigrinum*	Endangered	Red
Western Skink	*Eumeces skiltonianus*	Special Concern	Blue
Pigmy Short-horned Lizard	*Phrynosoma douglasii*	Extirpated	Red
Racer	*Coluber constrictor*	Special Concern	Blue
Night Snake	*Hypsiglena torquata*	Endangered	Red
Gopher Snake	*Pituophis catenifer deserticola*	Threatened	Blue
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue
Swainson's Hawk	*Buteo swainsoni*		Red
Ferruginous Hawk	*Buteo regalis*	Special Concern	-
Prairie Falcon	*Falco mexicanus*		Red
Peregrine Falcon	*Falco peregrinus anatum*	Special Concern	Red
Common Nighthawk	*Chordeiles minor*	Threatened	-
Lewis' Woodpecker	*Melanerpes lewis*	Special Concern	Red
Sage Thrasher	*Oreoscoptes montanus*	Endangered	Red
Lark Sparrow	*Chondestes grammacus*		Red
Brewer's Sparrow	*Spizella breweri breweri*		Red
Merriam's Shrew	*Sorex merriami*		Red
Preble's Shrew	*Sorex preblei*		Red
Pallid Bat	*Antrozous pallidus*	Threatened	Red
Western Small-footed Myotis	*Myotis ciliolabrum*		Blue
Fringed Myotis	*Myotis thysanodes*		Blue
Badger	*Taxidea taxus*	Endangered	Red
California Bighorn Sheep	*Ovis canadensis*		Blue
Great Basin Pocket Mouse	*Perognathus parvus*		Red
Western Harvest Mouse	*Reithrodontomys megalotis*	Special Concern	Blue
White-tailed Jackrabbit	*Lepus townsendii*		Red
Nuttall's Cottontail	*Sylvilagus nuttallii*	Special Concern	Blue

Grand Coulee Owl clover (Photo credit: Jenifer Penny)

12 Broadleaf Woodlands

What are broadleaf woodland ecosystems?

Broadleaf woodland ecosystems occur when ***succession*** has resulted in a broadleaf overstory at the ***climax stage*** of succession.

Broadleaf woodland ecosystems were divided into two distinct classes according to their environmental and vegetation characteristics: aspen copse and aspen seepage.

Aspen copse ecosystems

Within the study area, aspen copse ecosystems typically occur in broad, moist depressions near grassland areas. These communities are generally small ecosystems with trembling aspen overstories and shrubby understories dominated by common snowberry and rose. Soils are typically medium-textured. These sites are rich as the yearly input of leaf ***litter*** is quickly decomposed and mixed into the upper soil horizon by soil organisms.

Aspen seepage ecosystems

Aspen seepage ecosystems typically occur on slopes with subsurface seepage in a matrix of coniferous forests. These ecosystems are moist and rich as a result of nutrient inputs from seepage and the annual input of leaf litter. Aspen seepage ecosystems have trembling aspen overstories and diverse, shrubby understories. Soils are typically medium-textured. During field sampling, these ecosystems were only encountered in the Central Okanagan.

Table 37. Broadleaf Woodland ecosystem vegetation. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

	Aspen copse	Aspen seepage	
Trees			
trembling aspen	**	**	*Populus tremuloides*
Shrubs			
common snowberry	***	**	*Symphoricarpos albus*
Nootka rose	**	**	*Rosa nutkana*
saskatoon	*	**	*Amelanchier alnifolia*
choke cherry	*	**	*Prunus virginiana*
tall oregon-grape		**	*Mahonia aquifolium*
Douglas maple		**	*Acer glabrum*
Grasses			
blue wildrye	*	*	*Elymus glaucus*
Forbs			
star-flowered false Solomon's-seal	*	**	*Maianthemum stellatum*
mountain sweet-cicely	*	**	*Osmorhiza berteroi*
violets	*	*	*Viola* spp.

Wildlife

Amphibians & Reptiles: The moist and shady conditions of aspen stands offer a retreat for amphibians, snakes and their prey from the surrounding grasslands.

Birds: Broadleaf woodland ecosystems provide foraging and nesting habitat for a variety of perching birds, raptors and woodpeckers. Many owls, woodpeckers and other birds are dependent on cavities in broad-leaved trees for nesting. Shrubby understories are used for nesting by many species of songbirds. Some grassland nesting birds will move to aspen stands after the breeding season for the increased food availability.

Mammals: Broadleaf woodland ecosystems provide important summer shade and forage for many mammals. Bats often use these areas to hunt for insects, and deer and other animals seek forage and cover, particularly if there is a shrubby understory. Cavities provided by large aspen trees are essential to several species of bats and downed logs are used by small mammals

Why are they important?

Ecological and socio-economic values of broadleaf woodland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **At-risk status:** All broadleaf woodland ecological communities are listed as at-risk by the B.C. Conservation Data Centre (Table 38), along with several plant (Table 39) and wildlife species (Table 40) that use them.

- **High biodiversity:** Broadleaf woodland ecosystems offer moisture, shade, litter fall, structure and variety to a grassland landscape, which attracts a large number of wildlife species.
- **Specialized habitats:** Broadleaf woodland ecosystems are structurally diverse, and provide cover, food, and nesting habitat for many species. Aspen trees are very important for cavity nesters as they are prone to high levels of decay. The abundance of cavities provided by large aspen trees are very important for cavity nesters.
- **Social values:** Broadleaf woodland ecosystems provide opportunities for education, wildlife viewing, landscape viewpoints, walking and aesthetic enjoyment. The green space that woodlands provide can add to real estate values in adjacent areas.
- **Fragility:** These ecosystems are sensitive to soil disturbances because of the seepage associated with them.

Status

Broadleaf woodland ecosystems were isolated and uncommon; they covered only 0.5% of the study area (1737 ha). Historical mapping estimates that there has been approximately 44% loss of broadleaf woodland communities since 1800[68]. All broadleaf woodland ecosystems are a high priority for conservation and are at-risk due to urban development and clearing for vineyards and other agricultural uses.

Table 38. At-risk ecological communities of broadleaf woodlands

Common Name	Scientific Name	Provincial Status
Trembling aspen / snowberry / Kentucky bluegrass	*Populus tremuloides / Symphoricarpos albus / Poa pratensis*	Red

Table 39. At-risk plants of broadleaf woodlands

Common Name	Scientific Name	Federal Status	Provincial Status
Booth's willow	*Salix boothii*		Blue

Table 40. At-risk wildlife of broadleaf woodlands

Common Name	Scientific Name	Federal Status	Provincial Status
Great Basin Spadefoot	*Spea intermontana*	Threatened	Blue
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue
Western Screech-Owl	*Megascops kennicottii macfarlanei*	Endangered	Red
Lewis' Woodpecker	*Melanerpes lewis*	Special Concern	Red
Yellow-breasted Chat	*Icteria virens*	Endangered	Red
Brewer's Sparrow	*Spizella breweri breweri*		Red

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13 Coniferous Woodlands

What are coniferous woodland ecosystems?

Coniferous woodland ecosystems have open canopies of ponderosa pine or Douglas-fir. These communities occur in drier climates of the valley bottom, on rocky knolls, and on steep south-facing slopes where limited moisture or shallow soils limit tree growth. Fire exclusion has resulted in forest ingrowth on some sites, transforming stands from open Douglas-fir and ponderosa pine with grassy understories to dense stands with shrubby or a very minimal understory.

Coniferous woodland ecosystems were classified into five structural stages. Structural stages are important to identify different habitat values and the quality of the site (Table 41). Generally, older structural stages have higher conservation priority than younger structural stages. However, younger sites are important for buffers, and they provide necessary recruitment for older structural stages. Old coniferous woodlands are included in the Old Forest category.

Table 41. Structural stages of coniferous woodland ecosystems.

Code	Name	Definition
WD:3	Shrub/herb	Shrub cover 20% or greater, tree cover less than 10%
WD:4	Pole sapling	Trees are >10m tall and have 10% or greater cover, denser stands, generally 10-40 years old
WD:5	Young forest	Trees are >10m tall and have 10% or greater cover, dominated by young trees about 40-80 years old
WD:6	Mature forest	Trees are >10m tall and have 10% or greater cover, dominated by mature trees about 80-250 years old

Table 42. Coniferous Woodland ecosystem vegetation. Species denoted by an [x] indicates an alien species. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Trees		
ponderosa pine	***	*Pinus ponderosa*
Douglas-fir	**	*Pseudotsuga menziesii*
Shrubs		
saskatoon	**	*Amelanchier alnifolia*
antelope-brush	*	*Purshia tridentata*
Grasses		
bluebunch wheatgrass	**	*Pseudoroegneria spicata*
Idaho or rough fescue	**	*Festuca idahoensis* or *F. campestris*
Sandberg's bluegrass	**	*Poa secunda*
pinegrass	*	*Calamagrostis rubescens*
cheatgrass [x]	**	*Bromus tectorum*
Forbs		
arrowleaf balsamroot	**	*Balsamorhiza sagittata*
selaginella	**	*Selaginella* spp.
yarrow	**	*Achillea millefolium*
pussytoes	**	*Antennaria* spp.
slender hawksbeard	**	*Crepis atribarba*

Wildlife

Invertebrates: A large diversity of insects and arachnids occur in these ecosystems, including some rare grassland species that will use open coniferous forests.

Amphibians & Reptiles: An assortment of reptiles will forage in coniferous woodland ecosystems. Some snakes and lizards are most commonly found in open pine forests that offer downed logs, loose slabs of bark, or decaying stumps as cover. Bedrock features in shallow-soiled ecosystems may provide important denning opportunities. Amphibians may forage and burrow in coniferous woodlands, including some grassland frogs and salamanders that use deep-soiled, open woodlands.

Birds: Forest-dwelling birds, as well as some grassland birds, may be found in these open woodlands, including a variety of perching birds, raptors, and woodpeckers. Mature woodlands generally have higher habitat values due to habitat features such as large trees, snags, and cavities. Conversely, some species of birds, including a rare flycatcher, prefer younger stands of pine forest for nesting.

Mammals: Coniferous woodland ecosystems are home to numerous mammals that require the food and shelter provided by trees, and may support some grassland species that will use open forests for foraging or to seek shade and cover.

Why are they important?

Ecological and socio-economic values of coniferous woodland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **At-risk status:** Most native coniferous woodland ecological communities are listed as at-risk by the B.C. Conservation Data Centre (Table 43), along with many plant (Table 44) and wildlife species (Table 45) that rely on them. Many grassland species will also use coniferous woodlands, with an open stand structure. The species list for that ecosystem should be consulted as well.
- **High biodiversity:** Both forest and grassland species use coniferous woodlands, and some species rely on this unique transition between the two ecosystems. Mature woodlands are generally valuable to a larger number of species, but various ages of open forest stands provide habitats to a range of different wildlife.
- **Specialized habitats:** Large, old trees that possess cavities, gnarly branches, or deep furrows in the bark provide important habitat to many species. Dead or dying trees, downed logs and decaying stumps, especially with large slabs of loose bark, provide cover and insects for food to many small animals. In shallow-soiled, rocky ecosystems, cracks and crevices in exposed bedrock provide critical shelter to numerous species.
- **Fragility:** Coniferous woodland ecosystems commonly have shallow or sandy soils that are very sensitive to disturbance.
- **Social values:** Coniferous woodland ecosystems provide opportunities for education, wildlife viewing, landscape viewpoints, walking and aesthetic enjoyment. The green space that woodlands provide can add to real estate values in adjacent areas and act as tourist draws.

Status

Historically, coniferous woodland ecosystems occurred as a matrix with other ecosystems in the lowest elevations of the study area and as large patches elsewhere. In the study area, most coniferous woodland ecosystems have now been fragmented and altered by disturbances such as logging, forest ingrowth and invasive plants. Historical mapping estimates that there has been approximately 27% ecosystem loss of coniferous woodlands since 1800[69]. We found that relatively large portions of the study area were coniferous woodland ecosystems (14.7% of study area; 50,971 ha) and they comprised the largest sensitive ecosystems category.

Old coniferous woodland ecosystems are included within the old forest category because of their extreme rarity.

Most coniferous woodland ecosystems were mature forests (42%) or young forests (36%). Mature woodlands should be a high priority for conservation and preservation; younger structural stages are important in forming buffers and providing recruitment for older structural stages.

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Table 43. At-risk ecological communities of coniferous woodlands

Common Name	Scientific Name	Provincial Status
Douglas-fir - ponderosa pine / bluebunch wheatgrass	*Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata*	Red
Douglas-fir - ponderosa pine / bluebunch wheatgrass - pinegrass	*Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata - Calamagrostis rubescens*	Blue
Douglas-fir / shrubby penstemon - pinegrass	*Pseudotsuga menziesii / Penstemon fruticosus - Calamagrostis rubescens*	Blue
Ponderosa pine / bluebunch wheatgrass - Idaho fescue	*Pinus ponderosa / Pseudoroegneria spicata - Festuca idahoensis*	Blue
Ponderosa pine / bluebunch wheatgrass - rough fescue	*Pinus ponderosa / Pseudoroegneria spicata - Festuca campestris*	Blue
Ponderosa pine / red three-awn	*Pinus ponderosa / Aristida purpurea var. longiseta*	Blue

Table 44. At-risk plants of coniferous woodland ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Nettle-leaved Giant-hyssop	*Agastache urticifolia*		Blue
Two-spiked Moonwort	*Botrychium paradoxum*		Red
Lyall's Mariposa Lily	*Calochortus lyallii*	Threatened	Red
Slender Hawksbeard	*Crepis atribarba* ssp. *atribarba*		Red
Smooth Willowherb	*Epilobium glaberrimum* ssp. *fastigiatum*		Blue
Leiberg's Fleabane	*Erigeron leibergii*		Red
Hairstem Groundsmoke	*Gayophytum ramosissimum*		Red
Prairie Gentain	*Gentiana affinis*		Blue
Porcupinegrass	*Hesperostipa spartea*		Red
Oniongrass	*Melica bulbosa var. bulbosa*		Blue
Showy Phlox	*Phlox speciosa* ssp. *occidentalis*	Threatened	Red

Coniferous woodland

Table 45. At-risk wildlife of coniferous woodlands

Common Name	Scientific Name	Federal Status	Provincial Status
California Hairstreak	*Satyrium californica*		Blue
Silky Vallonia	*Vallonia cyclophorella*		Blue
Rubber Boa	*Charina bottae*	Special Concern	-
Racer	*Coluber constrictor*	Special Concern	Blue
Gopher Snake	*Pituophis catenifer deserticola*	Threatened	Blue
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue
Swainson's Hawk	*Buteo swainsoni*		Red
Flammulated Owl	*Otus flammeolus*	Special Concern	Blue
Common Nighthawk	*Chordeiles minor*	Threatened	-
Lewis' Woodpecker	*Melanerpes lewis*	Special Concern	Red
White-headed Woodpecker	*Picoides albolarvatus*	Endangered	Red
Gray Flycatcher	*Empidonax wrightii*		Blue

14 Sparsely Vegetated

What are sparsely vegetated ecosystems?

Sparsely vegetated ecosystems are defined as sites where rock or talus limits vegetation establishment; vegetation cover is discontinuous and interspersed with bedrock or blocks of rock. Sparsely vegetated ecosystems are subdivided into four sub-categories: shrub, talus, cliff, and rock outcrop ecosystems.

Shrub

Sparsely vegetated shrub ecosystems occur on small rock outcrops with cracks and crevices. These communities most commonly occur within a grassland matrix. These ecosystems are often steep and soils are restricted to small pockets. Scattered shrubs grow in cracks and cliff ferns often grow in small crevices.

Rock Outcrops

Rock outcrop ecosystems occur on areas of exposed rock that has very little soil development and sparse vegetation cover. Vegetation typically consists of bunchgrasses, selaginella and scattered shrubs that are generally restricted to crevices and pockets of soil. These ecosystems are gently to steeply sloping but are not vertical, nor are they dominated by shrubs.

Cliff

Sparsely vegetated cliff ecosystems are steep, vertical cliffs, often they occur above talus ecosystems. Cliffs have minimal vegetation that is restricted to cracks and crevices, narrow ledges and small soil pockets. Shrubs typically occur in crevices and grasses and forbs occur in small soil pockets on ledges.

Photo credit: Susan Latimer

Talus

Sparsely vegetated talus ecosystems occur on steep slopes covered with angular rock fragments. These communities usually occur below rock outcrops or cliffs. Soil is restricted to small pockets between rock fragments. Vegetation usually includes scattered trees, shrubs and cliff ferns. Occasional grasses and forbs are found growing in soil pockets between rock fragments. Vegetation cover is higher on sites with smaller rock fragments where there is more soil.

Table 46. Sparsely Vegetated ecosystem vegetation. Species denoted by an [x] indicates an alien species. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

	Shrub	Rock outcrop	Cliff	Talus	
Trees					
Douglas-fir	**			**	*Pseudotsuga menziesii*
Shrubs					
ponderosa pine	**				*Pinus ponderosa*
antelope-brush	**				*Purshia tridentata*
saskatoon	*	*	*	**	*Amelanchier alnifolia*
big sagebrush	*	**		*	*Artemisia tridentata*
mock orange				**	*Philadelphus lewisii*
smooth sumac				**	*Rhus glabra*
Grasses					
bluebunch wheatgrass	***	**		**	*Pseudoroegneria spicata*
junegrass	**	*			*Koeleria macrantha*
cheatgrass [x]	*	**			*Bromus tectorum*
Forbs					
selaginella	***	**	*		*Selaginella* spp.
cliff fern	*		*	**	*Woodsia* spp.
desert-parsley	*	*		*	*Lomatium* spp.
yarrow	*	*			*Achillea millefolium*
fleabanes and daisies	*	*			*Erigeron* spp.

Sparsely vegetated talus ecosystem (Photo credit: Kristi Iverson)

Wildlife

Amphibians & Reptiles: Snakes and lizards use sparsely vegetated ecosystems extensively. Ecosystems on warm aspects with deep cracks and crevices are used the most frequently, and may contain critical snake ***hibernacula***. Some amphibians are often found in rocky areas.

Birds: Birds of prey, including falcons, eagles, and hawks, often nest on rocky ledges found in sparsely vegetated ecosystems. Numerous smaller birds also nest on ledges, or in crevices and small caves. The Canyon Wren specializes in foraging for insects in rocky areas, especially talus.

Mammals: Over a dozen bat species occur in the Okanagan, and many of these rely on caves or rock crevices for roosting and rearing young, including most of the at-risk species. California bighorn sheep and goats require steep, rocky habitats to escape from predators, and numerous small and medium-sized mammals will use rock features for cover.

Why are they important?

Ecological and socio-economic values of sparsely vegetated ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **At-risk status:** Most sparsely vegetated ecological communities have been recommended for at-risk status (Table 47), and many of the plant (Table 48) and wildlife species (Table 49) that require these habitats are at-risk.
- **Specialized habitats:** Warm aspect rock features with deep crevices, or deep talus on warm slopes, provide critical hibernacula for over-wintering snakes, including many at-risk species. Even large rocks lying on the ground in these ecosystems can be very important, providing warmth and cover. Inaccessible crevices and small caves in large bedrock features are important to numerous bats for roosting and breeding. Ledges provide nest sites to a variety of birds.
- **Fragility:** Sparsely vegetated sites are sensitive to disturbance. They can take very long periods of time to recover.
- **Social values:** Sparsely vegetated ecosystems provide opportunities for scenic viewpoints, wildlife viewing, education, and aesthetic enjoyment. The green space that sparsely vegetated ecosystems provide can add to real estate values in adjacent areas and can draw tourists into the area.

Status

Sparsely vegetated ecosystems have not been well documented in the past, and they cover only 7.5% (26,023 ha) of the study area land base. Historical mapping estimates that there has been approximately 3% ecosystem loss of sparsely

vegetated communities since 1800[70]. At lower elevations, sparsely vegetated ecosystems tend to be threatened by urban development. The shallow soils and delicate nature of these ecosystems make them susceptible to significant damage from motorized recreation and other activities that disturb the soil.

Table 47. At-risk ecological communities on sparsely vegetated ecosystems

Common Name	Scientific Name	Provincial Status
Antelope-brush / selaginella	*Purshia tridentata / Selaginella*	Not yet ranked
Saskatoon - mock orange	*Amelanchier alnifolia - Philadelphus lewisii*	Not yet ranked
Selaginella - bluebunch wheatgrass	*Selaginella - Pseudoroegneria spicata*	Not yet ranked

Table 48. At-risk plants of sparsely vegetated ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Narrow-leaved Brickellia	*Brickellia oblongifolia* ssp. *oblongifolia*		Red
Watson's Cryptantha	*Cryptantha watsonii*		Blue
Cushion Fleabane	*Erigeron poliospermus var. poliospermus*		Blue
Strict Buckwheat	*Eriogonum strictum var. proliferum*		Red
Scarlet Gaura	*Gaura coccinea*		Red
Racemed Groundsmoke	*Gayophytum racemosum*		Red
Western Stickseed	*Lappula occidentalis var. cupulata*		Red
Flat-topped Broomrape	*Orobanche corymbosa* ssp. *mutabilis*		Red
Showy Phlox	*Phlox speciosa* ssp. *occidentalis*	Threatened	Red
Lemmon's Holly Fern	*Polystichum lemmonii*	Threatened	Red
Okanagan Fameflower	*Talinum sediforme*	Not at Risk	Blue
Thick-leaved Thelypody	*Thelypodium laciniatum var. laciniatum*		Blue

Table 49. At-risk wildlife of sparsely vegetated ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Western Skink	*Eumeces skiltonianus*	Special Concern	Blue
Silky Vallonia	*Vallonia cyclophorella*		Blue
Rubber Boa	*Charina bottae*	Special Concern	-
Racer	*Coluber constrictor*	Special Concern	Blue
Night Snake	*Hypsiglena torquata*	Endangered	Red
Gopher Snake	*Pituophis catenifer deserticola*	Threatened	Blue
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue
Prairie Falcon	*Falco mexicanus*		Red
Peregrine Falcon	*Falco peregrinus anatum*	Special Concern	Red
Canyon Wren	*Catherpes mexicanus*		Blue
Pallid Bat	*Antrozous pallidus*	Threatened	Red
Townsend's Big-eared Bat	*Corynorhinus townsendii*		Blue
Spotted Bat	*Euderma maculatum*	Special Concern	Blue
Western Small-footed Myotis	*Myotis ciliolabrum*		Blue
Fringed Myotis	*Myotis thysanodes*		Blue
California Bighorn Sheep	*Ovis canadensis*		Blue
Nuttall's Cottontail	*Sylvilagus nuttallii*	Special Concern	Blue

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15 Alpine

What are alpine ecosystems?

Alpine ecosystems occur at high elevations where the climate is too cold for tree establishment. Alpine ecosystems are generally dominated by low growing vegetation and are affected by microclimatic conditions which affect snow accumulation, wind exposure, sun exposure, and drainage of melt water. At the lower edge of the alpine, there are parkland forests consisting of clumps of trees interspersed with alpine vegetation. Trees may grow in a low ***krummholz*** form just above the parkland at the lower edge of alpine. Alpine ecosystems were only mapped within the TFL 15 SEI; other projects covered lower and mid-elevations.

Alpine ecosystems were subdivided into three subclasses: herbaceous, low shrub, and parkland forest ecosystems.

Herbaceous

Herbaceous ecosystems occur on a wide variety of microsites. These communities are dominated by forbs and ***graminoid*** vegetation. Soils are typically thin but may vary from moist to very dry.

Low Shrub

Low shrub ecosystems are dominated by low shrubs, such as heathers, scattered forbs and graminoids. These communities typically occur on microsites with accumulated, late-lying snow. Soils are typically thin, moist, and enriched with organic materials.

Photo credit: Kristi Iverson

Photo credit: Will Mackenzie

Parkland Forest

Parkland forest ecosystems occur at the transition between alpine and high-elevation montane forests. Subalpine fir, Engelmann spruce, and whitebark pine grow in distinct clumps together with shrubs, forbs and graminoid vegetation. Trees are often short and do not reach 10m in height. Soils are typically slightly shallow.

Table 50. Alpine ecosystem vegetation. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

	Herbaceous	Low Shrub	Parkland Forest	
Trees/shrubs				
whitebark pine		*	**	*Pinus albicaulis*
subalpine fir			**	*Abies lasiocarpa*
Engelmann spruce			**	*Picea engelmannii*
Dwarf shrubs				
pink mountain-heather	*	***	***	*Phyllodoce empetriformis*
grouseberry	**		***	*Vaccinium scoparium*
Graminoids				
sedges	***			*Carex* spp.
rushes	**	*		*Juncus* spp.
Piper's wood-rush	**		*	*Luzula piperi*
Forbs				
pussytoes	**	**	*	*Antennaria* spp.
subalpine daisy	**		*	*Erigeron peregrinus*
Sitka valerian	**		*	*Valeriana sitchensis*
arctic lupine	*		*	*Lupinus alpinus*
Mosses and Lichens				
haircap mosses	**	**	*	*Polytrichum* spp.
glow moss	**			*Aulacomnium palustre*
clad lichens		**	**	*Cladonia* spp.

Wildlife

Birds: A few hardy species of birds live in alpine and parkland areas, and many others will forage in these ecosystems during the short but productive summers, as insect abundance is often high.

Mammals: Many large carnivores, including bears, wolverines and badgers frequent alpine areas. Mountain goats can be found in or near steep or rocky areas in alpine ecosystems, and California bighorn rams may wander into this area in summer. Numerous small mammals such as marmots and ground squirrels are common in these ecosystems.

Why are they important?

Ecological and socio-economic values of alpine ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **At-risk status:** One ecological community is listed as at-risk by the B.C. Conservation Data Centre (Tables 51), however, there is little documentation on the extent of many alpine ecosystems and other ecological communities are likely to be considered at-risk in the future. Alpine areas are also important to some plant (Table 52) and wildlife species that are at-risk (Table 53).
- **Specialized habitats:** A variety of specialized habitats are found in alpine ecosystems including high elevation meadows, krummholtz and sites with significant snow cover for large parts of the year. These habitats provide specialized habitats for many alpine wildflowers.
- **Fragility:** Alpine ecosystems are sensitive to disturbance. They can take a very long time to recover due largely to the cold temperatures, shallow soils and high snow packs.
- **Social values:** Alpine ecosystems provide opportunities for scenic viewpoints, wildlife viewing, education, and aesthetic enjoyment. Alpine ecosystems can draw tourists into the area for hiking and skiing.

Status

These ecosystems have not been well documented in the past, and they covered only 0.1% (520 ha) of the study area land base. Alpine ecosystems were only mapped in the TFL 15 SEI. Most of the study area occurs at low elevations throughout the Okanagan Valley and this project does not give an adequate representation of the current state of alpine ecosystems in south-central British Columbia. In the study area, the greatest threats are high elevation logging, fragmentation and backcountry recreation.

Table 51. At-risk ecological communities of alpine ecosystems

Common Name	Scientific Name	Provincial Status
Western pasqueflower - black alpine sedge	*Anemone occidentalis - Carex nigricans*	Red

Table 52. At-risk plants of alpine ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Pink agoseris	*Agoseris lackschewitzii*		Blue
Alpine anemone	*Anemone drummondii var. drummondii*		Blue
Seep-spring Arnica	*Arnica longifolia*		Blue
Mount Hood pussypaws	*Calyptridium umbellatum var. caudiciferum*		Blue
Blackened sedge	*Carex epapillosa*		Blue
Holm's Rocky Mountain Sedge	*Carex scopulorum var. bracteosa*		Blue
Nuttall's draba	*Draba densifolia*		Blue
Lance-fruited draba	*Draba lonchocarpa var. thompsonii*		Blue
Buff daisy	*Erigeron ochroleucus var. scribneri*		Red
Alpine buckwheat	*Eriogonum pyrolifolium var. coryphaeum*		Blue
Little fescue	*Festuca minutiflora*		Blue
Brandegee's lomatium	*Lomatium brandegeei*		Blue
Wyeth's lupine	*Lupinus wyethii*		Blue
Suksdorf's bluegrass	*Poa suksdorfii*		Red
Elegant Jacob's ladder	*Polemonium elegans*		Blue
Diverse-leaved cinquefoil	*Potentilla diversifolia var. perdissecta*		Blue
Five-leaved cinquefoil	*Potentilla nivea var. pentaphylla*		Blue
Birdfoot buttercup	*Ranunculus pedatifidus* ssp. *affinis*		Blue
Alpine sorrel	*Rumex paucifolius*		Blue
Tweedy's willow	*Salix tweedyi*		Blue
Short-fruited smelowskia	*Smelowskia ovalis*		Blue
Umbellate starwort	*Stellaria umbellata*		Blue

Table 53. At-risk wildlife of alpine ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Wolverine	*Gulo gulo luscus*	Special Concern	Blue
Badger	*Taxidea taxus*	Endangered	Red
Grizzly Bear	*Ursus arctos*	Special Concern	Blue

16 Mature Forest

What are mature forest ecosystems?

Mature forest ecosystems are mapped where polygons include structural stage 6 forests[71] (mature forest). When mature forests occurred in riparian, broadleaf woodland, and coniferous woodland categories they were mapped as the latter categories, respectively.

Historically, most low-elevation forests (PP and IDF biogeoclimatic zones) had frequent surface fires that destroyed tree regeneration and allowed few trees into the overstory. Forest canopies were generally multi-aged with an increasingly complex canopy of mostly large, old trees. Understories were open and dominated by grasses and shrubs. Frequent fire limited the occurrence of dead wood to scattered large snags and large, downed wood.

The exclusion of frequent fires has transformed open, park-like forests to dense stands of Douglas-fir and ponderosa pine with understories dominated by regeneration. Mature forests occur where there are mature trees and a few large

71 Refer to Volume 2 (Iverson *et al.* 2003) for details on structural stage 6.

old trees. These stands typically have a history of selection logging and now have forest ingrowth, but the mature and old trees remaining are structurally important for wildlife. Mature forest sites provide excellent buffers for old forests and have good potential for restoration to historical stand structure. Many stands in the study area are at risk from catastrophic wildfire due to fuel build-up and to forest ingrowth.

On wetter sites and higher elevations (Montane Spruce (MS) and Engelmann Spruce – Subalpine fir (ESSF) biogeoclimatic zones), forest development occurs more quickly than on drier sites. Historically, these wetter sites did not burn as frequently and multi-layered forests were able to develop.

Coniferous mature forest ecosystems

Coniferous mature forests in the study area are dominated by ponderosa pine and Douglas-fir at low elevations and subalpine fir and lodgepole pine at higher elevations. These forests occur on sites with a wide range of ecological conditions. Typically, drier, low-elevation sites have ponderosa pine with some Douglas-fir in the overstory, and pinegrass and scattered shrubs and forbs in the understory. High-elevation sites usually have a mixed overstory of subalpine fir, lodgepole pine, and occasionally Engelmann spruce, with abundant grouseberry in the understory. High-elevation forests are mapped only in TFL 15.

Table 54. Coniferous mature forest vegetation in the South Okanagan. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

	Low-elevation	High-elevation	
Trees			
ponderosa pine	**		*Pinus ponderosa*
Douglas-fir	***		*Pseudotsuga menziesii*
lodgepole pine	*	**	*Pinus contorta*
western larch	*	*	*Larix occidentalis*
subalpine fir		**	*Abies lasiocarpa*
Shrubs			
saskatoon	**		*Amelanchier alnifolia*
birch-leaved spirea	**		*Spiraea betulifolia*
falsebox	*	*	*Paxistima myrsinites*
Grasses			
pinegrass	***	**	*Calamagrostis rubescens*
Forbs			
kinnikinnick	**	*	*Arctostaphylos uva-ursi*
heart-leaved arnica	*	*	*Arnica cordifolia*
wild strawberry	*	*	*Fragaria virginiana*
grouseberry		***	*Vaccinium scoparium*
Mosses			
ragged-moss		**	*Brachythecium* spp.
red-stemmed feathermoss	*	**	*Pleurozium schreberi*

Table 55. Mature forest vegetation in the Central and North Okanagan. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

	Coniferous	Mixed	Broadleaf	
Trees				
ponderosa pine	**	**		*Pinus ponderosa*
Douglas-fir	**	**		*Pseudotsuga menziesii*
paper birch		**	**	*Betula papyrifera*
trembling aspen		**	**	*Populus tremuloides*
Shrubs				
common snowberry	**	***	***	*Symphoricarpos albus*
tall oregon-grape	**	**	**	*Mahonia aquifolium*
saskatoon	**	**	**	*Amelanchier alnifolia*
Nootka rose	*	**	**	*Rosa nutkana*
Douglas maple		**	**	*Acer glabrum*
mock orange			**	*Philadelphus lewisii*
Grasses				
bluebunch wheatgrass	**			*Pseudoroegneria spicata*
rough fescue	**			*Festuca campestris*
pinegrass	**	**	**	*Calamagrostis rubescens*
blue wildrye		*	**	*Elymus glaucus*
Forbs				
arrowleaf balsamroot	**	*		*Balsamorhiza sagittata*
heart-leaved arnica	*	**	**	*Arnica cordifolia*

Mixed mature forest ecosystems

In the study area, mixed mature forests have both coniferous tree species, including Douglas-fir and ponderosa pine, and broadleaf tree species, including trembling aspen and paper birch. These ecosystems occur on moister sites than coniferous mature forest ecosystems and have shrubby understories with scattered grasses and forbs.

Broadleaf mature forest ecosystems

In the study area, broadleaf mature forest ecosystems have broadleaf tree species in the overstory including trembling aspen and paper birch. These ecosystems typically occur on moister sites than coniferous mature forest ecosystems and have shrubby understories.

Wildlife

Amphibians & Reptiles: Some temperate species of amphibians and reptiles will use mature, closed forests. Rattlesnakes will seek thermal shelter and will feed in these ecosystems in hot summers.

Birds: Many species of songbirds, woodpeckers and owls rely on mature forests. Features that resemble those offered by old forest are particularly important, including large trees and snags, large deformed branches, cavities, loose bark, and downed logs.

Mammals: Mature forests provide cover and forage to a number of mammals. The closed canopy and shrubby understory supply important food, security cover, thermal shelter, and snow-interception to numerous animals such as deer, particularly on warm aspects. Tree cavities and loose bark provide important habitats for small mammals and bats.

Why are they important?

Ecological and socio-economic values of mature forest ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **At-risk status:** Many mature forest ecological communities are considered at-risk by the B.C. Conservation Data Centre (Table 56) and some plant (Table 57) and wildlife (Table 58) that use these ecosystems are considered at-risk.
- **Future old forest ecosystems:** The extent of old forest ecosystems is extremely limited. With proper restoration, mature forests can develop into old forest ecosystems.
- **Biodiversity:** Mature forest ecosystems have many important structural attributes, including some remaining large, old trees. These ecosystems provide habitat for many species, and, where they occur, mature broadleaf trees are important for many cavity-nesting species.
- **Landscape connectivity:** Mature forests often provide buffers, and connectivity between other ecosystems.
- **Social values:** Mature forests provide opportunities for education, recreation, wildlife viewing and aesthetic enjoyment. The green space that mature forests provide can add to real estate values in adjacent areas. Mature forests provide opportunities for selection logging.

Status

We found that mature forest ecosystems covered 7.2% (25,048 ha) of the study area. These ecosystems should be preserved as large patches to provide recruitment for old forests. Most low-elevation mature forest ecosystems in the study area were ingrown and require thinning and prescribed burning to restore them to high quality sites that could become old forests.

Table 56. At-risk ecological communities of mature forest ecosystems

Common Name	Scientific Name	Provincial Status
Douglas-fir / common snowberry / pinegrass	*Pseudotsuga menziesii / Symphoricarpos albus / Calamagrostis rubescens*	Red
Douglas-fir - western larch / pinegrass	*Pseudotsuga menziesii - Larix occidentalis / Calamagrostis rubescens*	Red
Douglas-fir / common snowberry - birch-leaved spirea	*Pseudotsuga menziesii / Symphoricarpos albus - Spiraea betulifolia*	Blue
Douglas-fir / pinegrass - kinnikinnick	*Pseudotsuga menziesii / Calamagrostis rubescens - Arctostaphylos uva-ursi*	Blue
Douglas-fir / pinegrass - twinflower	*Pseudotsuga menziesii / Calamagrostis rubescens - Linnaea borealis*	Blue
Douglas-fir - ponderosa pine / Idaho fescue	*Pseudotsuga menziesii - Pinus ponderosa / Festuca idahoensis*	Blue
Douglas-fir - ponderosa pine / pinegrass	*Pseudotsuga menziesii - Pinus ponderosa / Calamagrostis rubescens*	Blue
Douglas-fir - ponderosa pine / snowbrush	*Pseudotsuga menziesii - Pinus ponderosa / Ceanothus velutinus*	Blue
Subalpine fir / grouseberry - Sitka valerian	*Abies lasiocarpa / Vaccinium scoparium - Valeriana sitchensis*	Blue
Subalpine fir / white-flowered rhododendron / sitka valerian	*Abies lasiocarpa / Rhododendron albiflorum / Valeriana sitchensis*	Blue

Table 57. At-risk plants of mature forest ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Nettle-leaved Giant-hyssop	*Agastache urticifolia*		Blue
Two-spiked Moonwort	*Botrrychium paradoxum*		Red
Lyall's Mariposa Lily	*Calochortus lyallii*	Threatened	Red
Slender Hawksbeard	*Crepis atribarba* ssp. *atribarba*		Red
Smooth Willowherb	*Epilobium glaberrimum* ssp. *fastigiatum*		Blue
Leiberg's Fleabane	*Erigeron leibergii*		Red
Hairstem Groundsmoke	*Gayophytum ramosissimum*		Red
Prairie Gentain	*Gentiana affinis*		Blue
Porcupinegrass	*Hesperostipa spartea*		Red
Oniongrass	*Melica bulbosa var. bulbosa*		Blue
Showy Phlox	*Phlox speciosa ssp. occidentalis*	Threatened	Red

Table 58. At-risk wildlife of mature forest ecosystems

Common Name	Scientific Name	Federal Status	Provincial Status
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue
Swainson's Hawk	*Buteo swainsoni*		Red
Western Screech-Owl	*Megascops kennicottii macfarlanei*	Endangered	Red
Flammulated Owl	*Otus flammeolus*	Special Concern	Blue
Williamson's Sapsucker	*Sphyrapicus thyroideus thyroideus*	Endangered	Red
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Yellow
Wolverine	*Gulo gulo luscus*	Special Concern	Blue
Fisher	*Martes pennanti*		Blue
California Bighorn Sheep	*Ovis canadensis*		Blue

17 Seasonally Flooded Agricultural Fields

What are seasonally flooded agricultural field ecosystems?

Seasonally flooded agricultural fields are lands that have been converted to agricultural use and experience flooding during wet seasons. These sites are primarily located along low lying areas and often on floodplains. Seasonally flooded agricultural fields have standing water at times throughout the year, providing habitat for amphibians, as well as waterfowl and other birds. Vegetation is often dominated by agronomic grass species.

Photo credit: Susan Latimer

Why are they important?

Ecological and socio-economic values of seasonally flooded agricultural ecosystems are listed below.

- **Agricultural benefits:** Seasonally flooded agricultural fields provide areas for growing crops.
- **Biodiversity:** Seasonally flooded agricultural fields provide important habitat for amphibians, waterfowl and other bird species, small mammals, and many types of predators (Table 59).
- **Linkages and travel corridors:** These sites provide opportunities for wildlife to travel between riparian and upland habitats.
- **Future riparian habitat:** These sites have the potential to recover riparian or wetland vegetation if agricultural use is discontinued. Some sites need to have the flood regime restored as they are often adjacent to channelized creeks or rivers.

Wildlife

Amphibians & Reptiles: Amphibians such as salamanders and frogs may use these areas for breeding when the fields are flooded or where ponding has occurred. These temporarily flooded areas are particularly important in locations where most permanent wetlands contain fish (that predate on amphibians). Some snakes may forage around these areas while flooded, and in them when dry.

Birds: Flooded agricultural fields provide foraging habitat for many birds, including curlews, herons and raptors. These large, flat, open habitats are favoured by some ground-nesting birds because of the ability to see predators from a long distance.

Mammals: While flooded, the edges of these sites are extremely productive for small mammals, and provide nesting opportunities while dry. In turn, this will attract carnivores such as weasels and coyotes, as well as other predators. Drier portions of the fields may provide burrowing opportunities to many small mammals, whose tunnels provide cover for many other species of wildlife. Ungulates such as elk, deer and sheep use fields for foraging. These insect-rich sites also provide important foraging habitat for many species of bats.

Table 59. At-risk wildlife of seasonally flooded agricultural fields

Common Name	Scientific Name	Federal Status	Provincial Status
Great Basin Spadefoot	*Spea intermontana*	Threatened	Blue
Gopher Snake	*Pituophis catenifer deserticola*	Threatened	Blue
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue
Great Blue Heron	*Ardea herodias herodias*		Blue
Swainson's Hawk	*Buteo swainsoni*		Red
Peregrine Falcon	*Falco peregrinus anatum*	Special Concern	Red
Long-billed Curlew	*Numenius americanus*	Special Concern	Blue
Bobolink	*Dolichonyx oryzivorus*		Blue
Badger	*Taxidea taxus*	Endangered	Red
California Bighorn Sheep	*Ovis canadensis*		Blue

Status

Seasonally flooded agricultural fields occupy 2291 ha or 0.7% of the land base in the study area.

Great Basin Spadefoot (Photo credit: Leah Ramsay)

18 Planning

Goals

The primary goal of the sensitive ecosystem guidelines is to conserve the ten sensitive ecosystems in a relatively natural state. The primary goal of the other important ecosystem guidelines is to maintain the resource values of those ecosystems and minimize the loss of ecosystem functions.

Using the SEI to Prioritize Sites for Conservation

For the Bella Vista – Goose Lake Range, Coldstream Vernon, District of Lake Country, and Vernon Commonage SEI's, the SEI and associated wildlife habitat mapping was used to develop an analysis as a first step in a conservation strategy. Sensitive ecosystems were assigned relative conservation ratings based on ecological condition, local and provincial rarity, sensitivity, and importance for wildlife habitat. Priority conservation areas were identified from the conservation rating map based on size, concentration and connectivity of high value areas. Identified conservation areas included core areas, buffers, wildlife corridors and other important features. These maps provide guidance for identifying priority areas for acquisition and developing a regional conservation strategy.

SEI maps can be used to set priorities for land management by highlighting priority areas for conservation. Areas containing concentrations of valuable habitat for at-risk species and ecosystems at-risk should be prioritized for conservation. ***Conservation assessments*** can be used to identify higher quality SEI units and can be used for prioritizing management areas.

On-site visits are needed to assess the site and to develop site-specific management recommendations.

SEI polygons should be considered in all levels of planning and mitigation strategies should be developed in areas where development will occur. SEI maps are intended to be used for broad-level planning; on-site visits are needed to assess site features, condition and threats so that site-specific management recommendations can be developed.

Developing a Conservation Strategy[73]

The intent of a conservation strategy is to convey the conservation goals and actions needed to maintain and enhance sensitive ecosystems, biodiversity and ecological processes and to protect or restore ecologically significant areas. The conservation strategy should be based on the information in the Sensitive Ecosystems Inventory and information on rare species and their habitats. If other biodiversity values are present conservation strategies should consider those as well. The plan should provide local and senior governments and other

73 Significant portions of this section have been adapted from McPhee *et al.* 2000.

stakeholders with conservation priorities, planning tools, strategies, and priorities for protection and land acquisition. These plans should assist in maintaining the long-term viability of sensitive ecosystems and biodiversity.

Various tools and mechanisms are available for ecosystem conservation depending on the ownership and the management policies and practices of the existing land managers. Because many sensitive ecosystems are on private property, the cooperation of landowners is essential to the long-term conservation of these ecosystems. Some conservation options include:

Designation as Environmentally Sensitive Areas (ESA) –The ten sensitive ecosystems should receive a priority designation in the identification of local government ESAs. In some cases, site boundaries should reflect the dynamic nature of the ecosystem (see **Delineate Buffers around Sensitive Ecosystems** below).

Several local governments in the Okanagan have been using SEI information to identify ESAs. ESAs are divided into several categories denoting relative ecological importance with separate management guidelines for each ESA category.

Designation as a nature or ecological reserve (or other similar protected status) – The most undisturbed, publicly owned remaining ecosystem fragments should be designated as conservation areas and permit only activities that do not impact the ecosystem. Grassland, antelope-brush steppe, wetland, old forest, broadleaf woodland and the highest quality riparian, coniferous woodland and sparsely vegetated sites should all be priorities for receiving protected status. Sites where different sensitive ecosystems occur adjacent to, or in close proximity to, one another should also be given priority for protection.

Acquisition of privately owned lands containing sensitive ecosystems should be pursued by both government and non-government organizations. Priorities should reflect those stated above for protected areas and should accommodate opportunities that arise as properties come up for sale.

Stewardship – Private landowners with sensitive ecosystems who wish to retain ownership could become involved in voluntary stewardship initiatives such as registering conservation covenants on their property to protect ecosystem values. The protection of grasslands, managing invasive plants, and managing forest ingrowth should all be priorities for stewardship programs.

Use other protection techniques such as cluster development, Development Permit Areas, restrictive covenants and incentives.

General Management Recommendations[74]

This section provides general recommendations to avoid negative impacts to sensitive ecosystems. These recommendations reflect the principles of biodiversity conservation and apply to all sensitive and other important ecosystems identified in the study area. Given the uncertainty of climate change on ecosystems, the best conservation approach may be to protect healthy and

74 Many of the management recommendations have been adapted from McPhee *et al.* 2000

resilient ecosystems, respecting both the biotic and abiotic components of the system, retaining the elements of structure, function and landscape features (i.e. terrain, soils and hydrology). When developing a management plan for sensitive or other important ecosystems, it is assumed that a local conservation strategy has been developed.

Delineate Buffers and Corridors around Sensitive Ecosystems

In order to achieve adequate protection, sensitive ecosystems must be buffered from adverse effects of land use practices in adjacent areas. For this reason, it is recommended that the protected area consist of the sensitive ecosystem core surrounded by an undisturbed vegetated buffer zone. Buffer zones can absorb and minimize negative edge effects that result from such things as neighbouring development, human access, increased domestic animal use, and colonization by invasive species. Buffers also play a role in maintaining microclimate conditions, particularly for wetlands and riparian areas, and buffering helps maintain the hydrological regime of sensitive ecosystems.

The size of the buffer zone will vary by ecosystem type, and by the constraints of the surrounding landscape. Buffers are particularly critical within urban and rural environments where human activities are prevalent. Fencing may be necessary along some buffers where adjacent development and activity is anticipated. In planning for protection of a particular site, assessments and recommendations should be made by a qualified professional[75] to ensure that conservation options are maximized.

In addition to buffering high priority areas, corridors are needed to connect conservation areas. Many streams and their associated riparian areas provide natural corridors in the study area. Maintaining riparian areas as corridors in conjunction with adjacent ecosystems helps to provide habitat complexity.

Bald eagles in black cottonwood trees in a riparian ecosystem. (Photo credit: Susan Latimer)

Wetlands and Riparian: Buffers play a role in maintaining microclimatic conditions. They help avoid increased temperature, decreased humidity, and increased noise levels particularly for wetlands and riparian areas. All native vegetation should be maintained in the wetland as well as the associated riparian ecosystem around the wetland. Adjacent land use that alters hydrology can negatively affect these ecosystems. Buffering helps to maintain the hydrological regime. Vegetated buffers should protect points of water inflow and outflow around wetlands.

75 At minimum, qualified professional personnel should include a registered Professional Biologist with extensive experience with the ecosystems and wildlife species in the Okanagan.

Wetland ecologists should be consulted to select an appropriate buffer zone. The ecologists should use the presence of ***hydrophytic vegetation*** and gleysols or mottled soils to determine the edge of the wetland and the boundaries of the hydrological system that influence the wetland. Buffers should also consider wildlife corridors and suitable terrestrial habitats for rare amphibians and turtles.

To maintain wildlife corridors and connectivity between riparian areas and other habitats retain the core riparian ecosystem, a vegetated buffer and the adjacent ecosystems. Larger streams with steep-sided canyons are natural areas for preservation because they tend to be difficult to build on and are frequently associated with unstable slopes.

Grassland, Sagebrush Steppe and Antelope-brush Steppe ecosystems: Buffers are important around grassland, sagebrush steppe and antelope-brush ecosystems because of the vulnerability of these ecosystems to soil disturbances and their susceptibility to the introduction and spread of invasive plants. Buffers are particularly important around these ecosystems because of their proximity to many urban developments.

It is important to conduct site assessments to determine appropriate buffers that will maintain continuity with adjacent sensitive ecosystems and wildlife habitat and protect the ecosystem from edge effects.

Forested ecosystems (Old Forests, Broadleaf and Coniferous Woodlands): Vegetated buffers around old forest ecosystems help prevent edge effects such as the introduction and spread of invasive plants and help reduce indirect disturbances. Mature forests can provide important buffers and recruitment areas for future old forest structure. Many species that are reliant on old forests also use other habitats therefore it is important to maintain connectivity with other ecosystems.

Broadleaf woodland ecosystems require buffers to maintain ecological viability, wildlife habitat values and to prevent the introduction and spread of invasive plants. Historically, broadleaf woodland ecosystems occurred as small to medium-sized patches with a high level of connectivity with grassland, old forest, and other ecosystems. Many of these connections are now lost and most of the larger patches of woodlands have been reduced in size. Because many wildlife values associated with these ecosystems are reliant on their connection with other ecosystems retaining these connections is vital.

Coniferous woodland ecosystems and the species dependent on them rely on their connectivity to other ecosystems. Maintaining landscape patterns with inclusions of other ecosystems in coniferous woodland matrices should be a priority for managing and conserving these ecosystems.

Sparsely vegetated and Alpine ecosystems: Many species that use sparsely vegetated and alpine ecosystems also rely on other types of ecosystems therefore vegetated buffers should be delineated to maintain connectivity to adjacent ecosystems.

Avoid Direct and Indirect Impacts

Minimizing negative impacts on sensitive ecosystems can be achieved through the following principles:

Discourage settlement and other development within or adjacent to sensitive ecosystems. This is particularly critical within rural environments and for new urban developments in areas that may still be of relatively high ecological value.

- Developments in or adjacent to sensitive and other important ecosystems can disrupt connections to other ecosystems, increase edges and cause fragmentation. Increased edges expand the opportunities for ecosystem disturbance.
- The soils of antelope-brush, grassland and sagebrush steppe ecosystems are highly desirable for cultivation, vineyards and orchards, however development of this type destroys the ecological attributes of these communities.
- Roads can lead to soil erosion and compaction and can spread or introduce invasive and alien species. Roads should not be built near wetland and riparian ecosystems as they can alter hydrology and lead to mortality of wildlife species.

The ecological functions and rarity of these ecosystems requires conservation of all remaining wetlands. Community leaders and local governments should be diligent in promoting the protection of every wetland in their area whether it is on private or public lands.

Maintain water quality.

- Wetlands provide ecological services, specifically water storage and maintaining water quality. When these functions are removed from an area through the loss or degradation of local wetlands, the costs to replace these services through technological means can be exorbitant. The ecological functions and rarity of wetlands require conservation of all remaining wetlands, including buffers to preserve the hydrologic regime, ecosystem function, and connectivity to other ecosystems. Community leaders and local governments should be diligent in promoting the protection of every wetland in their area whether it is on private or public lands.
- Maintain existing riparian vegetation and restore vegetation where it has been lost. Vegetation maintains the cohesive nature of the stream bank and reduces the power of the stream. During flood events, riparian vegetation catches fine nutrient-rich sediment, thus maintaining the productivity of the site. Without this vegetation, streams become wide and shallow, and sediment can accumulate in the stream channel where it may harm fish and reduce water quality. Many decades may be required to re-stabilize denuded stream banks and restore narrow, deep stream channels. Riparian vegetation also provides inputs of organic matter into soils, increasing their capacity to absorb and store water. Additionally, riparian vegetation moderates stream water temperatures, provides an important source of food for many aquatic organisms, and provides important cover for wildlife nesting and feeding.
- Maintain wetland hydrology. Draining or ditching in or around wetlands, filling in wetlands, and discharging stormwater into such sites should be

avoided. Do not remove vegetation cover as this increases surface runoff and reduces the amount of groundwater infiltration, thus reducing available summer moisture. Additionally, areas of impervious ground surfacing (i.e. pavement) should be minimized. Wetland hydrologists may need to be consulted to determine how to best protect wetland hydrology.

- Prevent the diversion of water bodies, the filling of wetlands, livestock access to water bodies and pesticide inputs to wetland and riparian ecosystems.
- To maintain ecological processes that safeguard water quality, prohibit development directly adjacent to water, wetland and riparian areas. Restoring natural water flows to riparian areas and wetlands may be recommended for specific sites.
- Wetlands store and filter water, and maintain water quality, therefore, adding urban storm drainage, agricultural runoff, and sediment from road building into wetlands should be prevented.
- Wetlands with artificially high nutrient levels may experience algal blooms, or may cause changes in vegetation composition.
- Protect buffers around wetland and riparian ecosystems as they play an important role in protecting water quality.

Protect wildlife and important wildlife habitats and features. A wildlife specialist should conduct a comprehensive inventory of species and wildlife habitat features in sensitive ecosystems to inform any management plans.

- Protect structural features. Large trees and snags, logs, rock crevices and dense shrubby thickets should be retained, as they represent important habitat features for many species of birds and other animals.
- Protecting shrub and forb vegetation is critical for ground nesters that use grassland, sagebrush steppe and antelope-brush steppe ecosystems.
- Known and potential breeding or denning sites, especially for vulnerable, threatened or endangered species, should be protected from disturbance. Protect all nesting and denning sites identified in the ecological inventory, such features may include dens, raptor nest or perch trees, owl roosts, woodpecker cavities, bat roosts, and snake hibernacula. Important habitat features should not be disturbed or removed.
- Do not disturb snake hibernacula. If snake hibernacula are found, they should not be disturbed and should not be made known to the public unless they occur in an area where public use may disturb snakes.
- Avoid any activity that would disturb breeding or denning individuals. Carry out restoration or development activities at the appropriate time of year to minimize impacts to wildlife. Avoid development activities from May through August. Always consult a wildlife specialist before beginning work.
- Pets should be controlled to avoid disturbing amphibians, waterfowl, and other birds especially during the breeding season (May through August).

Regulations requiring restraints may be needed during these times. Hunting dogs should be trained away from riparian areas during the breeding season.

- Many waterfowl are ground-nesters. Avoid haying in seasonally flooded field ecosystems during the nesting season.
- Allow natural flooding to occur in seasonally flooded ecosystems to improve wildlife habitat and to ensure continued health of adjacent riparian ecosystems.
- Do not use pesticides in or near wetland and riparian ecosystems to avoid harming rare invertebrates or other wildlife that eat insects. Healthy wetland ecosystems with natural vegetation attract numerous wildlife species that eat mosquitoes. Installing bat boxes and birdhouses can help control emerging mosquitoes.
- Avoid using insecticides in or near important foraging areas to avoid harming rare butterflies or other invertebrates, and wildlife that feed on insects
- Protect buffers around the ecosystem and retain connectivity to adjacent ecosystems.

Control the introduction and spread of invasive plants. A broad species management program may be required to deal with invasive plants such as diffuse knapweed (*Centaurea diffusa*), cheatgrass (*Bromus tectorum*), Purple loosestrife (*Lythrum salicaria*), common burdock (*Arctium minus*), common hound's-tongue (*Cynoglossum officinale*), and others.

- Retaining a healthy natural plant community and avoiding soil disturbances will help prevent invasions and using native species to reclaim disturbed sites can reduce the spread of invasive plants. Invasive species should be managed in a broad area around the sensitive ecosystem to control their spread. Managing human and livestock access will help prevent the spread of invasive plants. Vehicle use, including bicycles, should be avoided in all areas with invasive plants.
- Consult the BC Ministry of Forests and Range or BC Ministry of Agriculture and Lands to determine appropriate treatment methods for the particular species and site, and the best timing for treatment. It is important that the right treatment method is applied at the right time to ensure its effectiveness.
- Purple loosestrife (*Lythrum salicaria*), common burdock (*Arctium minus*) and common hound's-tongue (*Cynoglossum officinale*) are common invasive plants associated with wetland areas. These invasive plants can be cleared through hand pulling and mowing. It is not appropriate to use herbicides in or near wetlands or riparian areas. Re-planting with site suitable native species is recommended.
- In grasslands, sagebrush steppe and antelope brush steppe ecosystems, treat invasive plants with biological controls, spraying or hand-pulling. Plant native species to help prevent the establishment of more invasive plants. Attempt to

Invasion by great mullein (*Verbascum thapsus*) in a grassland ecosystem. (Photo credit: Peter Richardson)

minimize soil disturbance during removal of introduced plants to reduce the opportunity for further establishments.

- Sparsely vegetated ecosystems are very sensitive and it is important not to cause further disturbance when treating invasive plants. Invasive plants can be hand-pulled, and native species re-planted to help prevent the re-establishment of invasive plants.
- Controlling forest invasives such as cheatgrass, knapweed, sulphur cinquefoil will help maintain the ecological integrity of mature and old forest sites.
- Canada thistle and other unwanted introduced species commonly found in seasonally flooded fields can threaten wildlife, and the agronomic and native plant species in these important ecosystems.

Destruction of grassland habitat by all terrain vehicles. (Photo credit: Leah Ramsay).

Prevent soil disturbances. Recreational and grazing overuse in sensitive ecosystems can lead to soil disturbances resulting in damage and loss of vegetation cover and structure, and the introduction of invasive plant species. In wetlands, riparian ecosystems and broadleaf woodlands overuse can lead to soil compaction, while overuse in the drier ecosystems (grasslands, sagebrush steppe, antelope-brush steppe and coniferous woodlands) can lead to soil erosion. Horses and vehicle use, including bicycles and ATVs, can cause soil disturbances.

- Coniferous woodlands often have shallow or sandy soils, or occur on steep slopes that are sensitive to disturbance. Soil disturbance can allow invasive plants to establish and spread and can make it difficult for native plants to re-establish.
- Sparsely vegetated ecosystems have sensitive pockets of shallow soils, and frequently occur on steep slopes. Soil disturbance can allow invasive plants to establish or spread and can make it difficult or impossible for native plants to re-establish. Disturbing talus or bedrock may destabilize the remaining rocks and destroy critical habitat features. Hazard abatement activities, as often recommended by geotechnical assessments, are strongly discouraged. Appropriate buffers should be used instead.
- Alpine ecosystems are sensitive with pockets of shallow or wet soils. Soil disturbance can cause further erosion by wind and water and make it difficult or impossible for native plants to re-establish.
- Attempt to minimize soil disturbance during removal of introduced plants by hand-pulling or using bio-controls to reduce the opportunity for further establishments.
- Ensure that trails do not affect the root systems of trees, and do not create soil erosion or compaction problems.

Restrict recreational access. Managing access to high-use areas can help minimize the effects of recreation and other human uses. Designated trails, signage, and seasonal use restrictions may be useful in managing recreational use in sensitive ecosystems.

- Intensive recreational use of shoreline areas can reduce plant cover, compact soil, and disturb wildlife. Roots of trees and shrubs are easily damaged by trampling and trail development in the moist soils of wetlands. Trails often become wide in wet, muddy areas, and can increase sediment delivery to wetlands which in turn can affect amphibians and aquatic insects. Motorized vehicles, mountain biking, and horseback riding should be excluded in and around wetlands. Many recreational activities introduce or spread invasive species. Raised boardwalks should be used where trails are desired in wetland ecosystems.
- Recreational activities along wetland edges and canoeing in wetlands impact amphibians, nesting waterfowl, and other birds, and should be avoided during the breeding season (May through August). Avoid disturbing soils around wetlands, especially sandy soils that might be used by painted turtles for egg-laying.
- Pets should be controlled or restrained in all sensitive ecosystems.
- Rock climbing should be carefully managed on cliffs and should not be permitted without first determining which areas must be avoided to protect nesting and roosting habitats.
- Vehicle traffic, including bicycles and ATVs, in sensitive ecosystems can cause mortality to wildlife species and soil erosion and compaction problems.
- All motorized vehicles should be restricted to existing roads. Limit access by using fencing or railings and gates. Mountain bikes should be restricted to existing trails that are free of alien plants and not subject to erosion. Seasonal restrictions may be required to protect the ecosystem and the wildlife that depends on it.
- Do not develop new trails on antelope-brush ecosystems, grasslands, sagebrush steppes, sparsely vegetated or alpine ecosystems. Trails can create erosion problems, disturb fragile vegetation, and spread or introduce invasive plants. Road access should be avoided in these ecosystems.
- Trails should be closely monitored for invasive plants in all sensitive ecosystems. If invasive plants are present, trails should be closed until they have been treated and are under control. Erosion prone trails should be closed. Trails with invasive plants but no erosion problems can be re-opened once the invasive plants have been controlled.
- Where new trails are needed build a direct route to features of interest such as viewpoints or to stream crossings. The consequences of building new trails should be carefully considered before development. Ensure that trails will not affect the root systems of trees, and will not create soil erosion or compaction problems. Design trails to discourage use by vehicular traffic (ATV's), horses, and mountain bikes. Fences may be necessary in some places to prevent access.
- Where trails can be safely established, the appropriate recommendations listed below under "Plan Land Development Carefully" should be followed.

Manage livestock access. Livestock grazing needs to be carefully managed and monitored in sensitive ecosystems to ensure that grazing levels and timing meet management objectives for the site.

- Seasonal use-restrictions, fencing, and carefully managed livestock access represent management tools for controlling or avoiding the negative effects of access to sensitive areas.
- Many wetlands and ponds used for livestock are significantly altered. Overuse can lead to soil compaction, damage and loss of vegetation cover and structure, and the introduction of invasive plant species. Deep hoof prints along the water's edge can trap developing amphibian larvae as the water evaporates, resulting in death from lack of oxygen or dehydration. Alternative watering sites away from the wetland, or fencing to allow a single access point to the water can be used to maintain wetland functions and values while allowing some cattle use.
- Where fencing is required and practical, page-wire should not be used. Fences should be top-railed, and bottom wires should be 45cm above ground level to allow safe wildlife access.

Restore natural disturbance regimes. Restoration of grasslands, sagebrush steppe, old forests, mature forests, and coniferous woodlands requires an understanding of historical disturbance regimes (particularly fire), and an understanding of the structure of these ecosystems prior to fire exclusion. Historical photographs and written accounts, early forest or land surveys, and results from researchers in similar ecosystems can be used to determine the structure of historical ecosystems[76]. A qualified professional should develop a detailed restoration plan.

- While it is neither desirable nor feasible to end fire suppression, it is possible to consider thinning and prescribed burning to reduce ingrowth of Douglas-fir and ponderosa pine into steppe and coniferous woodland ecosystems, and to restore grassland habitat in high-priority conservation areas. Many sensitive ecosystems and structures that are important to wildlife (e.g., large old trees, including snags) are seriously at risk of loss to catastrophic wildfires that can result from high fuel build-up and ingrown stand structure. Areas with extensive invasive plants are not good candidates for prescribed burns but can still benefit from mechanical tree removal.
- Restore and maintain ecological structures and functions, and reduce the risk of catastrophic wildfire. Restoration should include retaining large, old trees and thinning of regeneration. After thinning conduct prescribed burns to consume unnaturally heavy fuels. Protect large old trees from excessive burning and root mortality by raking accumulated forest floor fuels away from tree bases prior to burning. Cut and remove lower branches and most small ponderosa pine and Douglas-fir to limit fire fuels. Invasive plants need to be

76 Swetman *et al.* 1999

controlled, and native plants may need to be seeded if there are inadequate native grasses and shrubs present on-site. Grazing should be deferred until the plant community has recovered[77].

It may be too dangerous to conduct a prescribed burn on small private lots. Landowners can reduce the risk of wildfire and maintain some of the ecological functions of old forest ecosystems on their land by retaining large old trees, raking and removing fuels from beneath trees, and by cutting and removing most small ponderosa pine and Douglas-fir.

- Remove encroaching trees. Large old trees are important habitat features that should be protected where they occur in antelope-brush, grassland, sagebrush steppe areas, but young trees should be removed by cutting or by prescribed fire. Prescribed burns should always be planned, properly scheduled, and conducted by a qualified professional.

Consideration should be given to restoring other natural processes and disturbance factors such as flood events.

- Allow natural wetland processes to maintain wetland functions and values. Beaver activity, flooding, seasonal drawdown, and groundwater recharge and discharge should be maintained. Inflow or outflow streams should not be diked or channelized.
- Allow natural riparian disturbances to occur. Flooding, windthrow, channel changes, slope failures and debris flows are recognized as important factors in the creation and maintenance of high diversity riparian habitats. These events and processes should be maintained as follows unless they pose a threat to safety or property.

Channelization of the Okanagan River (2006). (Photo credit: Leah Ramsay)

77 Moore *et al.* 1999

  - Minimize bank or flood protection. Human changes such as channel stabilization, depositing rip-rap, and removing vegetation reduce riparian diversity and habitats.
  - Maintain natural flow regimes. Deforestation, removal of vegetation, or increased impervious surfacing can result in significant increases in the size, duration, and frequency of floods.

- In seasonally flooded fields, allow natural flooding to occur to improve wildlife habitat and to ensure continued health of adjacent riparian ecosystems.

Plan Land Development Carefully

Where it is not possible to limit development within or immediately adjacent to a sensitive ecosystem, activities should be carefully planned to minimize adverse effects to the ecosystem. Qualified professional biologists should conduct a detailed inventory to determine the full species complement and ecological functions of the area. Surveys done at the wrong time of year may fail to uncover the presence of at-risk species or some critical habitat component for other species.

Inventories of vegetation, terrain features, adjacent water bodies and other important microhabitats are necessary to determine the full impact on biodiversity at the site. The occurrence of vulnerable, threatened, or endangered species, and at-risk ecological communities identified by the Conservation Data Centre should be given high priority for conservation. Each sensitive ecosystem chapter in this document has a list of the at-risk wildlife and plant species and ecological communities that may occur in that ecosystem in the Okanagan. It should be assumed those species are present if suitable habitat exists, unless some evidence demonstrates otherwise. Qualified professionals should work with the planning team to ensure that the sensitive ecosystem and potential wildlife habitat is protected. A list of relevant organizations that may assist in guiding development is provided in Appendix I.

Major land developments may require an Environmental Impact Assessment (EIA) according to provincial and federal legislation. The BC *Environmental Assessment Act* (*EAA*) and The *Canadian Environmental Assessment Act (CEAA)* are discussed in Chapter 22. Appendix IV provides information and suggestions for incorporating sensitive ecosystem information into EIAs.

The following guidelines should be applied when human settlement or other development is permitted in or adjacent to a sensitive ecosystem:

Require an ecological inventory conducted by a qualified professional.

Design roads and trails carefully.

- Avoid designing roads near sensitive ecosystems as much as possible. If roads must cross wetlands or riparian ecosystems they should be narrow and placed perpendicular to the ecosystem. Raised bridges are recommended to minimize soil and vegetation disturbance and to provide a wildlife corridor below. Where roads encroach upon wetlands, narrow the width of the road

and construct retaining supports on the down-slope side to avoid side casting material into the wetland. Roads should be set back from the ecosystem to ensure vegetation and bank stability are maintained.

- Avoid developing trails in or around sensitive ecosystems. If trails already exist ensure that they provide a direct route to a viewing area or stream crossing, and that they avoid sensitive vegetation, sensitive soils, seepage areas, erodable stream banks, or gully side walls.
- Ensure that trails do not affect the root systems of trees, and will not create soil erosion or compaction problems. Design trails to discourage use by vehicular traffic (ATV's), horses, and mountain bikes. Fences may be necessary in some places to prevent access. Trails should be closely monitored for invasive plants. If invasive plants are present, trails should be closed until they have been treated and are under control.
- Design all linear corridors to be as narrow as possible, and configure them to allow wildlife crossing.
- Avoid placing roads and trails near hibernacula. Determine locations of snake hibernacula prior to planning site layouts. Roads should not be located within 750m of hibernacula and barriers and underpasses may be required to prevent snake mortality.

Maintain hydrologic regimes.

- Changes to surface and ground water flow can negatively impact many sensitive ecosystems, especially wetlands, riparian and broadleaf woodland ecosystems. Broadleaf woodland ecosystems tend to be difficult to build on and are frequently associated with unstable slopes. Trails, roads, and housing developments must be designed to maintain the hydrology of these ecosystems.
- Ensure adequate sediment and erosion control measures are implemented.

Protect at-risk species and at-risk ecological communities by addressing the following recommendations:

- avoid disturbing sites where at-risk plants, wildlife and ecological communities occur;
- avoid disturbing nesting, denning, and roosting sites for at-risk wildlife;
- avoid disturbing important foraging areas for at-risk wildlife;
- maintain habitat structures such as crevices in rocks, trees with cavities, large old trees and snags, large downed logs, and understory vegetation which provide essential cover for many species of wildlife; and
- cut danger trees to a level where they are safe rather than removing the whole tree. Felled trees should be left on the ground.

A snag that could provide habitat values for cavity nesting species, including birds and bats.

Do not disturb nesting and breeding areas.

- Avoid development activities from May through August. Protect nesting and denning sites identified in the ecological inventory, such features include dens, raptor nest or perch trees, owl roosts, woodpecker cavities, and bat roosts.

Plan, design, and implement land development activities to avoid adversely affecting or disturbing:

- native vegetation;
- large diameter trees in all sensitive ecosystems and particularly cottonwood trees in riparian ecosystems;
- habitat structures such as crevices in rocks, trees with cavities, large old trees and snags, large downed logs, and understory vegetation which provide essential cover for many species of wildlife. Locate settlements and other developments away from these structures;
- natural processes such as stream flow, flooding, and stream channel movement;
- natural hydrological processes;
- vegetated corridors and connectivity between communities;
- protect soil conditions;
- nesting or denning sites;
- important foraging areas for at-risk wildlife;
- native shrubs, grasses, microbiotic crusts, soils and other terrain features such as bedrock, and other native vegetation;
- live and dead trees with cavities, decaying trees, downed trees, logs, snags, and leaf litter; and
- the root systems of trees.

All effort should be made to

- retain talus that occurs at the base of rock outcroppings;
- protect the steep faces of rock outcrops and cliffs; and
- avoid disturbing rock debris;

Restore native vegetation where it has been disturbed.

- Seed or plant native species from nurseries or plant native species that have been rescued from other development sites. Ensure that any native plant material used is free of invasive plants and their seeds.

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78 Hawkes *et al.* 1997

- Encouraging landowners and developers to maintain natural sites and to landscape with native species adapted to local conditions. Native plant gardening can help create wildlife habitat and minimize the need to water or irrigate.

Reduce Wildfire Threat across the Landscape

Most forests within the study area were historically maintained in open park-like conditions by frequent fires. Fire exclusion has resulted in structural changes to forests including increased stand densities, multiple layering in stands, and increased fuel loadings. Consequently, high severity stand-replacing fires that would likely result in a loss of biodiversity, site productivity, and create invasive plant infestation areas are more apt to occur than they did historically.

A landscape level assessment of wildfire risk, like the "Wildfire Threat Rating System" (WTRS) can document the areas that are at greatest risk[78]. This rating system is a GIS-based model that spatially quantifies the primary factors that affect wildfire risk. WTRS determines wildfire threat by incorporating four key components:

- fire risk;
- suppression capability;
- fire behaviour; and
- values at risk.

Once Wildfire Threat or some surrogate risk and hazard assessment has been completed, a fuel break strategy can be incorporated to identify areas that can be treated as fuel breaks in the event of a large fire. Fuel management strategies for private and public landowners can also be developed to help avoid the effects of severe fires and protect biodiversity values and private land values.

19 Future Directions

Updating SEI Products

New development, changes in land use, ecological succession and natural disturbances, will change components of the sensitive ecosystems map. Existing mapping can provide a baseline to changes in sensitive and important ecosystems in the study area. The mapping should be updated at least every ten years to reflect changes in the landscape. Structural stages of riparian, forest, and woodland ecosystems should be regularly updated.

Completing SEI Coverage

SEI mapping should be completed to provide full coverage of the Okanagan Valley. Complete coverage of the SEI would provide land managers with a strong tool for planning and development and would maximize their ability to maintain the ecological integrity of the landscape.

A side valley in the Okanagan (Photo credit: Peter Richardson)

Section II
Conservation Tools for Local Government, Landowners and Citizens and Senior Governments

20 What Local Governments Can Do

This section of the report provides general guidelines for local governments, landowners and other citizens for conserving and protecting ecosystems. Although the focus of the report is on the ten sensitive ecosystems and two other important ecosystems, the tools can also be used for conserving other environmentally sensitive areas (ESAs).

Planning

Except on federal lands such as Indian reserves, the constitutional authority for land use planning and regulation rests with the Province. Through various pieces of legislation, the Province has delegated much of its authority to local governments — to regional districts and municipalities. These powers include, for example, authority to adopt regional growth strategies, official community plans, zoning bylaws, subdivision bylaws, and other bylaws that affect development and conservation. Local governments have numerous planning tools available to assist them in protecting and conserving sensitive and other important ecosystems. Which tool is appropriate depends on a variety of factors, such as the ecosystem involved and the administrative capacity of the local government. In many cases, innovative plans can allow development to occur, that both conserves sensitive ecosystems and respects the legal rights of landowners.

The tools described below provide many options for crafting environmentally compatible development plans within local government jurisdiction. Developers can also use this report's information to incorporate conservation objectives into initial development designs to streamline approvals.

*The **Green Bylaws Toolkit for Conserving Sensitive Ecosystems and Green Infrastructure** is a comprehensive document that provides local governments with practical tools for protecting green infrastructure."[79] The toolkit explains the scope and provides bylaw examples of municipal and regional district jurisdiction for Regional Growth Strategies, Official Community Plans, Development Permit Areas, Zoning, Tax Exemptions, Environmental Assessment, Storm Water Management and other regulatory tools. It contains detailed case studies, other resources and commentary on how to craft successful green infrastructure projects and bylaws.*

Primary Goals

The primary goals of the policies and regulations described in this section are to conserve Sensitive Ecosystems (SE) in a relatively connected and natural state. For Other Important Ecosystems (OIE), the conservation goals are to maintain the resource use values while minimizing the loss of ecosystem functions.

Information Requirements

Sound information is needed to establish policy and a legal basis for protecting sensitive and other important ecosystems. Three types of information are considered in this chapter:

- **SEI ecosystems** are the ecosystems defined by the Sensitive Ecosystems Inventory (SEI). Information gathered by the SEI project is at an overview

79 Curran et al. 2007. www.greenbylaws.ca

level. Development proposals will require additional detailed inventories, field studies, and ground truthing to ensure that habitat has been accurately and thoroughly identified. SEI information can be used by local governments to designate Environmentally Sensitive Areas (ESAs) and Development Permit Areas (DPAs). Ecological information collected during the SEI field checking and the management recommendations in this report can be used as Development Approval Information.

*See **Local Government Act** sections 903, 904, 919.1 and 920 for more information.*

- **Environmentally Sensitive Areas (ESAs)** are areas formally identified as environmentally sensitive by the local government. Sensitivity may be due to ecological concerns or the existence of natural hazards. Local governments may assemble maps and databases for identifying and managing ESAs within their boundaries. ESAs may be mapped at an overview scale or in considerable detail, depending on the local government needs. ESAs may be protected using the planning tools outlined in this Chapter, such as zoning and development permit areas.

*See **Local Government Act** sections 920.01 and 920.1 for more information.*

- **Development Approval Information (DAI)** or impact reports may be required from developers as part of the development approval process. An Official Community Plan can specify areas for, or circumstances in which a local government can require information about the impact of the development, such as on the natural environment. A local government must, by bylaw, establish procedures and policies on the process for requiring the information and the substance of the information required.

Information Verification

To ensure adequate information is available for managing sensitive ecosystems, local governments may:

- Establish procedures for verifying and ground-truthing areas for inclusion in ESAs, as part of planning updates and development approvals.
- Confirm, review and refine areas identified by the SEI as candidates for inclusion in ESA inventories or maps.
- Enact bylaws and OCP policies to require Development Approval Information for all Sensitive Ecosystem ESAs pursuant to the *Local Government Act*, sections 920.01 and 920.1.
  - Establish procedures, policies, and terms of reference for providing information and institute criteria for the types, sources, quality, and reliability of information.
  - Use the Sensitive Ecosystems Inventory and information in this report as a basis for defining the circumstances and rationale for ESA designation.
- Involve the public, non-government organizations, environmental, fish, and wildlife agencies, and qualified professional consultants to assemble and evaluate ESA studies and review Development Approval Information. This can be accomplished through workshops, open houses, advisory groups, or other approaches to gather local knowledge and information.

- Establish an interagency review process, which includes the regional district and the affected municipality, to review the environmental, archaeological and socioeconomic considerations of the proponent's plans for development.

Regional Growth Strategies

Regional growth strategies (RGS) are a regional coordination mechanism available to regional districts.[80] A RGS is a 20 year vision that represents agreement between member municipalities and the regional district. According to the *Local Government Act* (section 849), regional growth strategies are intended "to promote human settlement that is socially, economically and environmentally healthy and that makes efficient use of public facilities, land and other resources". The purpose of a RGS is to coordinate services and harmonize approaches on regional issues such as growth management, environmental protection, transportation, affordable housing and economic development.

Although a RGS is not mandatory, the process for its development is contained in Part 25 of the *Local Government Act*. A regional district initiates a RGS, which is prepared in consultation with affected agencies, local governments and the public. Once a regional growth strategy has been enacted, municipalities must include a 'context statement' in their Official Community Plan (OCP) that describes the relationship of OCP policies to the strategy, and identifies how they will be made consistent over time. It is the regional context statements that align municipalities with the regional vision. All regional district bylaws and services enacted after a RGS must be consistent with the RGS.

Of the six RGS in the province to date, four contain a version of an urban containment boundary and all of them have environmental protection policies. Local governments can use a RGS to express agreement on acquiring priority ESAs as parkland and to designate regional greenways and habitat corridors. A RGS can incorporate regional conservation plans and other regional documents that detail the protection of green infrastructure. Ideally, a RGS sets regional priorities for environmental protection.

See ***Local Government Act*** *Part 25 (sections 848-871) for more information.*

Official Community Plans

An official community plan (OCP) provides overall policy direction for the local government and establishes the basis for its regulations and development permits. It sets out community objectives for land use and operations. OCPs may include goals and policies that define the local government's intention to protect and conserve sensitive ecosystems.

OCPs may contain policies for the "preservation, protection, restoration and enhancement of the natural environment, its ecosystems and biological

80 In the Okanagan Valley, the Central Okanagan Regional District has a Regional Growth Strategy, the Okanagan – Similkameen Regional District is expected to adopt one in 2008, and the Regional District of North Okanagan is in the process of developing one.

diversity"[81]. OCPs do not authorize or require local governments to do specific things, but any development proposals, works, or projects must be consistent with the OCP. The OCP helps municipal councils and regional boards make decisions on land use applications. OCP polices provide direction to approving officers when considering whether a proposed subdivision serves the public interest under the *Land Title Act*.

*See **Local Government Act** sections 875-890 for more information.*

For local governments who intend to conserve and protect sensitive ecosystems, the following policies are suggested models (see sidebar) that could be incorporated into OCPs. The common policies suggested below are relevant to all sensitive ecosystems unless otherwise noted. Additional policies specific to individual ecosystems are also presented.

Suggested OCP Policy Approaches for all Sensitive Ecosystems

***When using suggested policies in developing Official Community Plans** Actual legal documents should be customized to reflect local practices and conditions Readers should seek legal advice when preparing new legal documents and bylaws, or when interpreting existing ones.*

- Recognize the importance of sensitive ecosystems as a part of the natural environment and biological diversity of the region, and as an important component of green space and natural features for the community.
- Develop a local government-led biodiversity plan with the assistance of non-government environmental agencies and the public. The plan should:
  - use ecosystem, habitat, and environmental inventories developed by agencies such as the Ministry of Environment, Canadian Wildlife Service, Fisheries and Oceans Canada, and other environmental inventories collected using approved government inventory standards;
  - identify a network of ecosystems that exist within the larger landscape;
  - identify isolated ecosystems;
  - establish or enhance corridors, connections, and linkages between isolated ecosystems to create larger ecosystem networks; and
  - promote connectivity between ecosystems and discourage fragmentation of contiguous ecosystems and ecosystem components to preserve landscape diversity, and allow wildlife use, movement, and dispersal.

*See **Local Government Act**, section 878.*

*See **Local Government Act**, sections 919.1 and 920.*

Designate ESAs as Development Permit Areas (DPAs) in the OCP. Using information in this report and other resources such as the Green Bylaws Toolkit, draft guidelines in the OCP for development or land use changes in these areas.

Suggested OCP Policies in the Green Bylaws Toolkit[82]

- Dedicate ESAs as parks or trailways, or to a private land trust or non-government organization.
- Use conservation covenants to protect ESAs on private land.
- Register statutory rights-of-way under the *Land Title Act*.

81 *Local Government Act, section 878*
82 Curran *et al* 2007 www.greenbylaws.ca

- Adopt bylaws to exempt eligible riparian property from property taxes where a riparian property is subject to an appropriate conservation covenant under section 219 of the *Land Title Act*.
- Use density bonusing, clustering housing, and other development incentives to facilitate protecting sensitive ecosystems.
- Amalgamate lots to achieve greenways and ESA goals outside of urban containment boundaries.
- Designate DPAs for protection of the natural environment as areas for which Development Approval Information may be required.
- Regulate land uses in DPAs to encourage development that is compatible with the preservation, protection, restoration, and enhancement of sensitive ecosystems.
- Maintain appropriate buffers, determined by qualified professionals, around sensitive ecosystem areas that consider processes of natural erosion, deposition and movement of natural boundaries (see sidebar).
- Design roads and utilities with sensitivity to the environment. Plan these at a landscape scale to minimize impacts to ESAs.
- Seek to acquire and conserve sensitive ecosystems and other important ecosystems as open green space and parkland
- Manage recreational access to ESAs to minimize impacts especially during wildlife breeding seasons. Prohibit pets from running at large.
- Provide technical advice and staff assistance to landowners to become involved in stewardship initiatives such as ecosystem restoration and enhancement, and to register conservation covenants on private property.

*See **Local Government Act**, sections 920.01 and 920.1*

*See **Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia**[83]*

Additional Policy Suggestions for Wetland and Riparian Ecosystems

- Consider the overall hydrology affecting the ecology of the ESA. Ensure land use plans maintain natural surface, groundwater and nutrient regimes to support existing hydrology and ecological processes.
- Adopt an integrated storm water (rainwater) management approach where water is dealt with at its source and maximum infiltration of rainwater is supported.
- Maintain continuous riparian corridors of sufficient width to protect fish and wildlife habitat and to accommodate the dynamic nature of the hydrologic system, and reduce the need for channel stabilization and flood controls.
- Protect water quality from pollutants, sedimentation or altered nutrient loading.

83 Ministry of Environment 2006

- Establish development setbacks from wetland and riparian areas to help maintain ecological function.
- Locate road and utility corridors to retain natural connections to surrounding upland ecosystems for wildlife movement. Design roads that maintain ecosystem vegetation, soils, bank stability, hydrology and other functions.

Additional Policy Suggestions for Old Forest and Coniferous Woodland Ecosystems

- Cluster development away from old forest and coniferous woodland ecosystems.
- Develop a tree bylaw to control the annual rate and extent of cutting old forest and coniferous woodland ecosystems.
- Work with private forest landowners to:
  - encourage appropriate forest management plans that reduce forest ingrowth and fuel loads, and sustain the structure and composition of old forest and coniferous woodland ecosystems;
  - provide adequate buffers between old forests, coniferous woodlands and developed areas to reduce the need to remove or top "hazard" trees; and
  - retain patches of natural forests, as well as open meadows with isolated trees.

These suggested policies dealing with forested land do not apply to forestry activities on private forest land that is subject to the Private Managed Forest Land Act and regulations. Local governments are prohibited from passing any bylaws that restrict forest management activity on those lands.

Additional Policy Suggestions for Grassland, Disturbed Grassland, Antelope-brush Steppe, Sagebrush Steppe, and Sparsely Vegetated Ecosystems

- Recognize the extremely sensitive and vulnerable nature of these ecosystems to almost any human disturbance.
- Cluster development away from grassland, antelope-brush steppe, sagebrush steppe, and sparsely vegetated ecosystems.
- Work with landowners to discourage development that fragments these ecosystems into small patches.
- Restrict and enforce recreational access, including rock climbing, into these ecosystems to minimize impacts, especially during wildlife nesting seasons.

Zoning

*See **Local Government Act**, sections 903-904.*

Zoning bylaws designate how parcels of land in different areas of the municipality may be used and how much of that use (the density) is allowed on each parcel. Zoning bylaws can regulate the use and density of land and structures, as well as the size and siting of structures and uses permitted on the land. Zoning regulates the shape and dimensions, including minimum and maximum sizes, of parcels of land that may be created by subdivision. Zoning can maintain large lots and low density development in rural and ecologically

sensitive areas, while directing development to less sensitive higher density areas (urban or village) that are already serviced by infrastructure. Local governments can:

- Review boundaries for zones established under section 903(1)(a) of the *Local Government Act* to ensure that zoning boundaries recognize sensitive ecosystems where possible.
- Define sensitive ecosystems as a "siting circumstance" as contemplated in the *Local Government Act*, section 903(3)(e). This provision can be applied where the location of sensitive ecosystems may not be precisely defined but can be described in relation to the characteristics of the resources on site.[84] This is particularly useful for imprecise, evolving, and ambulatory resources such as a stream corridor or ecosystem. The "siting circumstance" provision allows zoning regulations to be defined and applied for parcels near sensitive ecosystems. Caution should be exercised to avoid vagueness or uncertainty in defining "siting circumstance". Development permit provisions may provide more flexibility.
- Review allowed uses in zones near or within sensitive ecosystems. Amend bylaws to prohibit or regulate uses that would have adverse impacts on sensitive ecosystems.
- Review regulations for density, lot size, and site coverage for zones near or within sensitive ecosystems. Amend bylaws to ensure these regulations are compatible with conservation requirements for sensitive ecosystems.
- Review regulations for siting, size, and dimensions of uses and buildings for zones near or within sensitive ecosystems. Amend bylaws to ensure that these regulations are compatible with conservation requirements for sensitive ecosystems.
- Establish setback provisions for buildings, structures and other development to protect sensitive ecosystems. Note that setbacks under section 903 of *Local Government Act* are subject to variance by the Board of Variance under sections 899 to 902.
- Continue to implement the flood plain setbacks and regulations under Section 910 of the *Local Government Act*.
- Create density bonus zones for residential areas adjacent to ESAs. This allows developers to apply for increased density on non-sensitive portions of the site in exchange for conserving a substantial area as a protected ESA and donating as parkland. Density bonusing may require complex, site planning analyses. Municipalities frequently use development agreements and zoning amendments to affect density bonuses.[85]

Clustering development allows developers to maintain housing densities while protecting sensitive ecosystems. Density bonuses can provide an incentive to promote clustering of buildings and roads in a small area (e.g. 10%) of a parcel and conserving the sensitive ecosystems as parkland or with conservation covenants.

*See **Local Government Act**, section 904.*

84 Buholzer 2001.
85 Buholzer 2001.

- Create cluster housing zones for residential areas adjacent to ESAs. This allows a tighter grouping of houses or multiple-unit buildings on the most "build-able" portions of the site in exchange for retaining a large area of the land in a natural state as an ESA. Lot averaging provisions within zoning categories permit a variety of lot sizes, which facilitate concentrating development in non-environmentally sensitive areas

See ***Strata Property Act.***

- Encourage bare land strata subdivisions for residential areas adjacent to ESAs. This can promote cluster housing while keeping sensitive areas as common space protected with a conservation covenant.
- Ensure zoning categories define adequate parcel sizes and dimensions in the event of future rezoning or subdivision. Following subdivision there must be enough non-sensitive area in each new parcel to allow the uses defined in the current zoning.

See ***Conservation Covenants*** *for more information.*

- Ensure sensitive areas (including those in common land portions of bare land strata subdivisions) are protected from future development by conservation covenants in the name of the regional district, municipality, and/or non-government environmental or conservation organizations.
- Use comprehensive development zones for complex sites in urban areas to promote careful site planning to conserve sensitive ecosystems.
- Designate slopes that exceed 25 percent as a "siting circumstance" and establish building setbacks of at least 20 metres (horizontal distance) from slopes.

Development Permits

See ***Local Government Act,*** *sections 919.1 and 920 for more information.*

The *Local Government Act* permits Council, in an Official Community Plan, to designate DPAs for the protection of the natural environment and establish guidelines for how construction will address the special environmental conditions identified in the OCP. Within a DPA an owner must obtain a development permit before subdividing land, or constructing, adding to or altering a building, or altering the land.

Development permits are one of the most important tools available to a local government for protecting sensitive ecosystems. Development permits establish requirements that may apply to land development or redevelopment. Permits can include specifications for preserving, protecting, restoring and enhancing the natural environment, its ecosystems, and biological diversity. Development permits may also dictate site level requirements for development activities.

Development permit guidelines set out the scope of what may be required in a development permit, and the guidelines are enunciated in an OCP or in zoning bylaws. The more detailed the guidelines directing how development must occur, the better the protection that can be provided to sensitive ecosystems. Development permit guidelines are not applicable to forestry activities on private forest land that is subject to the *Private Managed Forest Land Act* and regulations. Local governments are prohibited from passing any bylaws that

restrict forest management activity on those lands. In addition, local governments cannot use development permits to control farming activities.

The following suggested development permit guidelines are recommended (see sidebar) and, unless noted, apply to most sensitive ecosystem categories. Additional provisions are provided for specific ecosystems.

Suggested Development Permit Area Guidelines for all Sensitive Ecosystems

See ***Local Government Act****, section 919.1.*

- Designate sensitive ecosystems as DPAs for protection of the natural environment as provided in section 919.1(1)(a) of the *Local Government Act*. Include sufficient contiguous land within the DPA to allow appropriate planning for sensitive ecosystems protection.
- Designate portions of sensitive ecosystems prone to hazardous conditions as DPAs as provided in section 919.1(1)(b) of the *Local Government Act*.
- Provide justification for designating the ESA as a DPA, and create guidelines for development in a sensitive ecosystem, as per section 919.1(2) of the *Local Government Act*. The justification can set out baseline information related to special conditions and objectives justifying the designation of sensitive ecosystems.
- Require a Development Permit prior to subdividing land; constructing, adding to, or altering a building or structure; or alteration of land including disturbing vegetation, deposit or removal of soil, or any other activity that could disturb sensitive ecosystems within DPAs.
- Require that sensitive ecosystems be preserved, protected, restored, or enhanced in accordance with conditions in the development permit.
- Stipulate that sensitive ecosystems disturbed prior to an application for a development permit be restored or enhanced to a natural condition as a requirement of a development permit.
- Require **Development Approval Information**, prepared by a qualified environmental professional, for all DPAs for the protection of the natural environment, to include as a minimum:
  - a topographic survey with an appropriate contour interval;
  - an inventory of natural biophysical features including soils, vegetation, water bodies, watercourses, wetlands, wildlife species, ecological processes, and other ecosystem components (see sidebar);
  - identification of populations, habitats, or natural features supporting rare, threatened, and endangered species. Information from wildlife habitat maps can be used to help guide inventories;
  - confirmation of the boundaries of sensitive and other important ecosystem ESAs;
  - description of site development plans and operations; and

When using suggested guidelines in creating Development Permits, *actual legal documents should be customized to reflect local practices and conditions. Readers should seek legal advice when preparing legal documents or bylaws, or when interpreting existing ones.*

- assessment of potential environmental effects of activities proposed for the site on sensitive and important ecosystems and watercourses.

- Require an applicant to engage a qualified professional to prepare an **environmental site plan**, as an integral part of a Development Permit for any DPA that includes or abuts a sensitive ecosystem. The plan should ensure that development will not create offsite effects that adversely affect that ecosystem. The site plan should:
  - detail specific construction approaches that will preserve, protect, restore, and enhance the natural environment, ecosystems, and biological diversity of sensitive ecosystems within the DPA;
  - include provisions to maintain connectivity between adjacent sensitive ecosystems and other important habitats, and be consistent with landscape level initiatives where these are available;
  - specify terms and conditions regulating any activities that may adversely affect or disturb species, vegetation, soils, watercourses, natural features, or ecological processes of sensitive ecosystems within the DPA, where such disturbance is unavoidable;
  - define measures for professional environmental supervision, inspection, and monitoring of development activities and related environmental effects on sensitive ecosystems occurring during and after development;
  - identify when the developer will engage a qualified professional at key times during construction when onsite consultation is needed and wildlife could be at-risk from construction activities;
  - clearly flag the area where development will occur and equipment be operated; and
  - identify which native plants will be salvaged and used in final landscaping, restoration of disturbed areas along roadways, and enhancement of surrounding natural areas.

- Stipulate that all areas within DPAs for protection of the natural environment remain free of development, except for areas identified as suitable for development in an approved Development Permit and associated environmental site plan.

- Require that development in less sensitive portions of the DPA be planned, designed, and implemented in a manner that will not adversely affect or disturb the sensitive ecosystems. This should be tailored to site specific conditions, including attention to protecting:
  - vegetation, trees, snags, and root systems;
  - rare and uncommon species and natural plant communities;
  - soils and soil conditions;
  - terrain features such as rock;
  - birds and other wildlife and their habitats, such as hibernacula, nesting

and breeding areas (time development to avoid disturbing wildlife during breeding seasons); and to:

- designing buildings to blend into the profile and colour scheme of the hillside;
- incorporating xeriscaping into landscaping wherever possible;
- ensuring all street and yard lights are shrouded to minimize light pollution.

- Require the development to conform to all municipal bylaws, federal and provincial legislation, regulations, and standards.
- Require developers to construct habitat features for Species at Risk that could benefit local populations, such as water retention ponds for breeding amphibians and antelope brush/yarrow stands for Behr's Hairstreaks.
- Implement a plan to control the introduction or spread of invasive plant species. Disturbed sites should be planted with appropriate native species. Consult qualified professionals, the BC Ministry of Agriculture and Land, or the BC Ministry of Forests and Range for recommendations on controlling invasive plant species.
- Conduct pre-construction clearing during the dormant months (Nov-Feb) to avoid periods when animals are most active and prone to encounters.
- Implement appropriate sediment and erosion control measures to protect silt from smothering low plant growth.
- Require trees and other vegetation that are lost as part of land development be replaced with native plants appropriate to the ecosystem, with preference for replacement by plants salvaged from disturbed areas of the site.
- Require that any works for preserving, protecting, restoring, or enhancing sensitive ecosystems be maintained for a specific period of time to ensure their success in performing their intended function over time.
- Require applicants to post security in the amount of 100 percent of the cost of restoring the site.

Consider ***density bonuses***, ***cluster housing***, relaxing servicing requirements (such as street widths), riparian tax exemptions or other innovative planning tools to achieve development designs that protect sensitive ecosystems. Designs should incorporate the following principles:

- Promote and maintain natural buffers adjacent to sensitive ecosystem areas, where possible, that:
  - recognize natural processes and changing natural boundaries;
  - insulate the ecosystem from uses that would cause adverse effects;
  - avoid disturbing or removing native vegetation;
  - emphasize native vegetation species compatible with the ecosystem;
  - deter the spread of invasive species into the ecosystem;
  - deter grazing by livestock;

- avoid creating access routes (i.e. trails) to or through sensitive ecosystems;
- deter predation and disturbance of wildlife by pets and domestic animals; and
- maintain wildlife corridors between the sensitive ecosystem and nearby wildlife habitat patches.

See Environmental Objectives, Best Management Practices and Requirements for Land Development.[86]

- Maintain connectivity and linkages with adjacent sensitive ecosystems and other habitat areas through the use of corridors and greenways.
- Minimize fragmentation of sensitive ecosystems and corridors.
- Where utilities, servicing, and infrastructure are required near sensitive ecosystems, the following recommendations apply:
  - avoid locating these works within ESAs and associated buffers;
  - permit their location within ESAs and associated buffers only where the installation is necessary, such as essential public roads, utilities, public works, pathways and creek or ecosystem restoration or protection measures, or where there is no other physical alternative in the determination of the local government, except to locate within an ESA;
  - require installations to be located and designed so that sensitive and important ecosystems can be maintained when adjacent lands are developed;
  - require that any disturbed sensitive ecosystems be restored and enhanced to maintain, at minimum, the previously existing natural conditions and functions of the sensitive ecosystem;
  - require construction to be managed to avoid adverse effects on sensitive and important ecosystem functions and condition;
  - contain road disturbance as much as possible, minimizing cuts and fills and retain structures, such as locked freestone blast rock;
  - do not sidecast greater than 0.5 metre in height, and/or use natural weathered rock to retain fill;
  - seek to reduce road widths wherever possible, particularly in areas where parking is not required or encouraged;
  - install traffic calming devices to ensure drivers are careful to avoid wildlife on roadways;
  - install a rail fence in appropriate areas to exclude livestock and contain motorized traffic;
  - use oversized culverts under access roads to provide wildlife underpasses; and
  - engage a qualified professional to rescue wildlife that becomes trapped in ditches for underground servicing.

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- Favour designs that minimize roads, trails and other public access to sensitive and important ecosystems, and:
  - require applicants to use Best Management Practices to avoid impacts;[87] and
  - require applicants to install appropriately-designed fencing, rails, pathways, elevated board walks, signage, and access controls, where necessary. Ensure they do not impede wildlife access between the sensitive ecosystem and adjacent habitat areas.
- Any access should be designed using environmentally sensitive approaches and aligned to:
  - provide the least intrusive and disruptive route to viewing areas;
  - avoid areas with high soil compaction or erosion potential;
  - avoid rare natural plant communities or rare plant species; and
  - prevent intrusion into wet areas including seepage sites and wetlands.
- Where the development site contains or is adjacent to a natural water course, work with the developer to:
  - dedicate the riparian corridor to the local government or secure its long term protection with a conservation covenant;
  - prevent access to the watercourse by construction activities, except as approved by appropriate government agencies;
  - ensure that the flow of the watercourse is not polluted by sediment or toxic materials during construction and is not obstructed or impeded;
  - preserve and restore the watercourse to natural condition, including planting or retaining vegetation and trees;
  - preserve, protect, restore, or enhance fish habitat or riparian areas, control drainage, control erosion or protect banks; and
  - comply with provisions of the *BC Water Act, Canada Fisheries Act* and *BC Fish Protection Act (including the Riparian Areas Regulation).*

Additional Guideline Suggestions for Wetland and Riparian Ecosystems

- Follow the standards and procedures set out in the Riparian Areas Regulation (RAR) with the goal of developing a DPA process that exceeds RAR requirements to achieve greater riparian and watercourse protection than standard setbacks.
- Consider development permit provisions that require protection, restoration, or enhancement of watercourse environments on the development site, or if this is not possible, elsewhere within the catchment area of the watercourse.

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- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb riparian and wetland ecosystems, including:
  - maintaining natural processes related to disturbance events and ecological succession, such as natural flow regimes of streams, seasonal flooding, stream channel movement, ***senescence of seral species***, windthrow or blow-down of trees, and natural slope failures;
  - leaving standing dead and dying trees, snags, fallen trees, downed logs, and similar forest features in the riparian ecosystem; and
  - maintaining natural corridors and connectivity of species and habitats with upland ecosystems.
- Maintain the natural groundwater and surface water hydrologic systems that support the wetland and riparian ecological processes by doing the following:
  - retain professional biological and hydrologic services to advise on treatment of hydrology in the environmental site plan;
  - require proponents to enlist qualified professionals to calculate baseline flow regimes to determine optimum water levels as part of an integrated watershed stormwater management strategy;
  - maintain existing volumes, flows, and timing of stormwater drainage and stormwater infiltration or recharge to groundwater systems, except where alterations would restore or enhance natural regimes;
  - minimize the volume of stormwater runoff and the extent of impervious materials covering groundwater infiltration areas, and use effective infiltration approaches such as **"grasscrete"**, **exfiltration galleries**, or other techniques to compensate for loss of pervious surfaces;
  - maintain natural ecological processes that support the wetland and riparian areas including flooding, seasonal drawdown, beaver activity, sediment accretion, and groundwater recharge and discharge;
  - protect water quality from pollutants and sedimentation from the development site; and
  - avoid ditching and draining works within the hydrologic zone of the wetland or riparian area.
- Avoid locating road and utility corridors along, parallel to, or across riparian ecosystems in order to maintain unconstrained natural connections for wildlife to surrounding upland ecosystems. Where crossings are necessary, bridges are recommended to minimize disturbance of soil and vegetation and to provide a wildlife corridor below. Roads should be narrow and placed perpendicular to the riparian ecosystem. Roads should be set back from the riparian ecosystem to ensure the riparian vegetation and bank stability are maintained.
- Require measures to preserve, protect, restore or enhance fish habitat and riparian areas, to control drainage and erosion, and to protect banks.

- Minimize **windthrow**, susceptibility to invasive species, and loss of interior or non-edge habitats by:
  - keeping riparian corridors as wide as practical with buffers of trees well-rooted in deep soil;
  - maintaining wildlife corridors between the riparian and wetland ecosystems and nearby upland ecosystem patches;
  - ensuring trees in the buffer areas are given stabilization treatments as necessary, to ensure a wind-firm edge; and
  - where possible, ensuring trees at the windward edge are located in deep soils and well-rooted. Work under the supervision of a qualified professional. Use an arborist certified by an International Society of Arboriculture to assess trees before topping or pruning.
- Avoid trail, fencing, or landscape materials that would adversely affect wetlands and riparian areas, such as limestone, bark mulch, and preserved wood.
- Plant restored areas adjacent to urban areas with wind-firm species.
- Avoid removing snags and downed logs during development.

Additional Guideline Suggestions for Antelope-brush Steppe, Sagebrush Steppe, Grassland and Disturbed Grassland Ecosystems

- Where practical, require Development Approval Information that:
  - assesses the ecological condition and wildlife habitat potential of the ecosystem
  - identifies rare, threatened, and endangered species and their populations; and
  - identifies habitats and natural features that support rare, threatened, and endangered species and their populations.
- As a component of the environmental site plan:
  - conserve grasslands and disturbed grasslands;
  - maintain associated wildlife habitat;
  - conserve adjacent habitats, such as riparian areas, broadleaf and coniferous woodlands, grasslands, and other habitats;
  - maintain connectivity with adjacent habitats; and
  - minimize human access to ranch and wildlife habitat areas.

Additional Guideline Suggestions for Old Forest and Coniferous Woodland Ecosystems

- As part of the environmental site plan, require a qualified professional to prepare a tree management plan to reduce and minimize forest ingrowth.

Consider:

- removing large, old, unsound trees only where these are a hazard to the public; and
- retaining tree densities similar to those that occurred on the site prior to European settlement.

Additional Guideline Suggestions for Other Important Ecosystems – Mature Forest Ecosystems

- Maintain mature forests at historical densities with reduced fuels and forest ingrowth.
- Retain mature forests as buffers around sensitive ecosystems.
- Minimize fragmentation of mature forests by large-scale developments, roads and other linear developments, and clear-cutting.
- Where practical, require Development Approval Information that:
  - assesses the ecological condition and wildlife habitat potential of mature forest ecosystem areas;
  - identifies rare, threatened, and endangered species and their populations; and
  - identifies habitats and natural features that support rare, threatened, and endangered species and their populations, such as patches of rare plants, nesting trees or snags.
- As a component of the environmental site plan:
  - protect rare, threatened, and endangered species and their populations, including their supporting species, habitats, or natural features;
  - conserve large-diameter live, standing dead trees, dying trees, and snags; and
  - reduce fuels and forest ingrowth.

Subdivision Approvals

Subdivision applications are considered by an approving officer authorized under the *Land Title Act*. Municipal approving officers are municipal employees, usually the director of planning or engineering. In regional districts, approving officers may be employees of a regional district or of the Ministry of Transportation. Local government councils and boards have no discretion over applications for subdivision.

The *Land Title Act* requires an approving officer to ensure that subdivisions conform to local government bylaws such as zoning and subdivision servicing bylaws. An approving officer cannot approve an application that is contrary to the local government's bylaws. They also have substantial independent authority to determine whether or not a proposal is in the public interest and to specify

requirements for subdivisions. The *Land Title Act* enables the approving officer to:

- Refuse or ask for amendments to an application because the application is not in the "public interest." An application that is contrary to the public interest can include one that does not conserve sensitive and important ecosystems. The approving officer takes direction from local government policies and documents, such as the OCP and DPA guidelines, to evaluate what is the public interest. Provincial agencies may review subdivision referrals and develop general or site specific environmental or conservation recommendations for approving officers.
- Require that the developer donate sensitive ecosystems to local governments as parkland as part of neighbourhood and subdivision designs. Approving officers may:
  - During subdivision, require up to five percent of the land being subdivided to be dedicated for park or public open space under section 941 of the *Local Government Act*.
  - Consider, where appropriate, the use of road and water body access dedication requirements for provision of stream and wildlife corridors.
- Where acquisition or dedication is not appropriate or possible, seek the registration of a covenant on the title to land to preserve ESAs. Covenants can be used to require environmental protection measures such as retaining vegetation, keeping sensitive areas free of development and in a natural condition, and installing fencing to restrict access. Covenants can be in favour of a local government, senior government agency, land trust and/or a conservation organization. Covenants must be enforced to be effective.

Subdivision Servicing Bylaws

Section 938 of the *Local Government Act* establishes subdivision servicing bylaws. These bylaws set standards and make requirements for providing works and services, such as access (roads, sidewalks, trails, transit stops), water, sewer, and storm drain systems when land is subdivided. To protect sensitive and other important ecosystems, subdivision servicing bylaws may:

- Incorporate Best Management Practices (BMPs) and guidelines into works and service standards, requirements, and operational procedures.[88] BMPs attempt to ensure that operations are compatible with preserving, protecting, restoring, and enhancing sensitive and important ecosystems. Important functions include stormwater management, stream protection, vegetation management, and erosion and sedimentation control.
- Require that all public works, including road, utility and park construction be conducted in a manner consistent with environmental protection of ESAs.

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Stream and Drainage Policies and Bylaws

The *Local Government Act* and *Community Charter* enable local governments to enact stream and drainage policies and bylaws that can address protecting sensitive and other important ecosystems. Maintaining natural drainage cycles, preserving stream corridors, and allowing the maximum amount of rainwater to infiltrate the soil where it falls, are key policy goals. Some stream and drainage management approaches will be subject to the BC *Water Act*, the Riparian Areas Regulation under the BC *Fish Protection Act*, and the Canada *Fisheries Act*. Local governments can, and are encouraged to:

- Establish integrated stormwater drainage policies for drainage facilities and land development activities that:
  - maintain the natural hydrology of watersheds, groundwater, streams, and other water bodies; and
  - regulate development work within stream corridors.
- For municipalities, enact or amend a watercourse protection bylaw pursuant to the *Community Charter's* Spheres of Concurrent Jurisdiction Regulation – Environment and Wildlife regulation. Such a bylaw can restrict anyone from polluting, obstructing or impeding the flow of a stream, creek, waterway, watercourse, waterworks, ditch, drain, or sewer, and impose penalties for contravention.
- Adopt an open streams policy that limits crossing, confining, covering, or piping of watercourses.
- Identify "lost streams" that have been covered by culverts or other covers, and consider "day-lighting" these streams where practical and feasible.
- Establish a program to identify and remove obstacles impeding fish passage such as inappropriately designed culverts and stream crossings.
- Enact or amend a runoff control bylaw for watersheds in which there are ESAs, pursuant to section 907 of the *Local Government Act*, to:
  - establish a maximum percentage of area that can be covered by impermeable material; and
  - establish standards for the ongoing disposal of surface runoff and stormwater from paved areas and roof areas during and after construction to maintain natural runoff volumes and water quality.[89]
- Enact or amend parking bylaws under section 906 of the *Local Government Act* to regulate surface treatments to avoid runoff impacts on sensitive and important ecosystems.

89 BC Ministry of Water, Land and Air Protection (2002). Stormwater Planning: A Guidebook for British Columbia

Tree and Landscaping Policies and Bylaws

The *Local Government Act* and *Community Charter* enable local governments to enact tree and landscaping policies and bylaws that may assist in the protection of environmentally sensitive ecosystems. Regional district tree regulation powers are limited to the regulation of tree cutting on land that is subject to flooding, erosion, land slip or avalanche. Municipalities can apply tree cutting regulations on all land. Local governments are encouraged to:

A landscape bylaw may be a substitute for a tree bylaw in areas under regional district jurisdiction where tree bylaws apply only to lands subject to flooding, erosion, land slip, or avalanche.

- Enact or amend a tree bylaw to:
  - designate ESAs for special tree cutting regulations;
  - require permits for the removal or pruning of ecologically significant trees within ESAs; and
  - where removal of a hazardous tree within an ESA is essential, require special care be exercised to minimize disturbance to surrounding vegetation, fish, wildlife and their habitat.
- Enact or amend a landscaping bylaw under section 909 of the *Local Government Act* to:
  - set standards for screening and landscaping that preserves, protects, restores, and enhances sensitive and other important ecosystems including reducing forest ingrowth and wildfire threat;
  - regulate landscaping to conserve sensitive and important ecosystems by prohibiting the planting of invasive species and requiring landscaping with native species; and
  - enforce regulations to ensure landscaping maintenance protects sensitive and other important ecosystems.

Soil Removal and Deposit Bylaws

The *Local Government Act* and *Community Charter* enable local governments to enact soil removal and deposit policies and bylaws that may assist in the protection of environmentally sensitive ecosystems. Local governments can and are encouraged to:

- Enact or amend a soil removal and deposit bylaw that:
  - regulates soil removal and deposit to ensure ESAs are protected and conserved during and after land development and redevelopment;
  - ensures that development plans near ESAs include appropriate designs and procedures for controlling erosion and sedimentation; and
  - require special care be exercised to minimize disturbance to surrounding vegetation, wildlife and wildlife habitat where soil movement is approved within or near an ESA.

Animal Control Bylaws

The *Local Government Act* and *Community Charter* empower local governments to enact bylaws for keeping animals and for regulating animals on highways and public spaces, including ESAs and sensitive ecosystems. Bylaws should control pets and livestock that may endanger wildlife or damage vegetation in these areas. It is important to note, however, that local government regulation of animals cannot interfere with normal farm practices under the BC *Farm Practices Protection (Right to Farm) Act*. The local government may:

- Regulate or restrict the keeping of dogs, horses, cattle, sheep, goats, swine, rabbits, or other animals and define areas where they may or may not be kept. Defined areas could include ESAs and DPAs.
- Require dog owners to keep dogs on leash or under the control of a competent person while on publicly owned ESAs and sensitive areas of public parks, stream corridors, and roadsides.
- Regulate or restrict running or straying of cattle into sensitive areas such as ESAs and stream corridors.

Partnerships

Stewardship of the environment is everyone's responsibility. Local governments can build partnerships with other governments, non-government organizations, and the public by:

- Providing leadership for developing a long term strategy to acquire priority ESAs, including:
  - acquiring and preserving ESAs as part of local parks programs;
  - identifying acquisition priorities in co-operation with non-government and government conservation organizations;
  - identifying priorities for protection through development permit, rezoning, subdivision, and other regulations; and
  - acquiring additional lands that focus and limit the spatial growth of communities and provide a natural landscape setting for a community.
- Establish intergovernmental partnerships with senior governments to facilitate a "one window" approach to planning and approvals. Coordinating regulations among the various levels of government could allow owners, developers and the public to deal with one contact point in government. This could speed approvals, reduce confusion and provide more effective enforcement.
- Adopt a bylaw under section 811 and 811.1 of the *Local Government Act* (for regional districts) or section 225 of the *Community Charter* (for municipalities) to exempt eligible riparian property from property taxes where a property is subject to a riparian conservation covenant under section 219 of the *Land Title Act*. Provide information on property tax incentives for protecting riparian land through conservation covenants where this bylaw has been adopted.

- Direct landowners to sources of advice about federal tax benefits for ecological gifts.
- Coordinate stewardship awareness programs with senior governments, local conservation organizations, and schools to increase public awareness and support for conserving sensitive and important ecosystems and existing ESAs, and to promote active stewardship and restoration activities.
- Encourage and educate pet owners to control pets that prey on or disturb birds, small mammals, or other species, or disturb sensitive or other important ecosystems.
- Co-operate with provincial and federal government programs to protect sensitive and important ecosystems, and fish and wildlife habitat. Consider supplementing municipal environmental policies with environmental and sustainable development guidelines of federal, provincial, and regional government agencies.

See the Canadian Ecological Gifts Program at http://www.cws-scf.ec.gc.ca/egp-pde/

21 What Landowners and Citizens Can Do

Local and senior government policies, legislation and their enforcement are just part of the equation when conserving sensitive ecosystems in the Okanagan. Implementing all the measures necessary to secure protection of environmentally sensitive areas (ESA) is limited by the availability of public financial assistance and concerns of private property owners over regulation of their land. The voluntary efforts of land owners and citizens are therefore essential for the conservation and enhancement of sensitive and other important ecosystems. Described below are several conservation related initiatives that land owners and other citizens can undertake.

Learn About the Natural Environment

The value of educating society about natural areas, including sensitive ecosystems, cannot be over-emphasized. Education is the foundation of all private land protection tools. For some natural areas, public awareness may be the only tool available to provide protection. People who know and respect the value of natural areas may be more inclined to try to protect them. Concerned citizens and land owners may become more motivated to secure the protection of natural areas through the various means described in this section.

Encourage children to join a young naturalists or streamkeepers group.

Children are our future land stewards. Parents and citizens have a responsibility to teach children about nature — a walk in a forest or along a river helps to forge a connection with nature[90]. Contact your local natural history organization, to find out about nature programs available.

> "Natural areas" is used as a general term describing areas that have not been developed or irreparably degraded, and includes "sensitive ecosystems". Natural areas are not equivalent to "sensitive ecosystems" as they may not possess the attributes of the ecosystems described in the previous section, however they still retain natural elements and wildlife habitat values worthy of protection or restoration.
>
> The chapter on local government introduces the term "Environmentally Sensitive Area (ESA)". This term is used for natural areas formally designated by local government as environmentally sensitive (See *Local Government Act* sections 920.01 and 920.1 for more information).

90 Cornell 1989, Louv 2005

Be Good Stewards of Your Own Land

Stewardship is the active management of land so that natural values can be retained; stewardship represents the most common and age-old method of caring for land[91]. Stewardship may be a conscious decision not to develop land in order to protect its natural values or may include development in a responsible manner.

In the study area, almost 37% percent of the landbase is privately owned and approximately 50% is federal or provincial crown land. These statistics might make it seem that conservation efforts to protect land should be directed mainly at governments rather than at private property owners[92], but conservation cannot adequately occur without protection and stewardship on private lands. Land owners need to be aware of senior and local government legislation that also applies to private land.

What Landowners Can Do

Private land owners can be good stewards of their land by:

- learning more about the natural values on their land;
- allowing natural areas to remain undeveloped;
- restoring damaged ecosystems;
- enhancing wildlife habitat;
- maintaining wildlife trees and modifying them only if a hazard is identified[93];
- ensuring garden plants are not invasive[94];
- removing invasive plant species;
- remembering that we all live downstream[95], and the importance of responsible disposal of chemicals and pesticide use;
- taking garden waste and prunings to local composting facilities;
- learning about historical open forest structure and removing young trees accordingly; and
- preventing access to natural areas by domestic animals and pets.

A stewardship publication that can assist land owners in the above actions is published by Naturescape BC called *The Stewardship Series: Caring for Wildlife Habitat at Home*[96]. Another helpful resource is *The Stewardship Centre for British Columbia*[97], an on-line central storehouse of stewardship resources.

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91 Land Trust Alliance of BC 2007

92 Findlay and Hillyer 1994

93 A new wildlife tree guidance report (June 2006) is available at http://www.for.gov.bc.ca/HFP/values/wildlife/WLT/index.htm and the Federation of BC Naturalists has a wildlife tree stewardship resource site at http://www.wildlifetree.org/

94 See http://www.invasiveplantcouncilbc.ca/publications/IPC-Hort-Brochure.pdf

95 Living By Water program http://www.livingbywater.ca

96 See http://www.hctf.ca/naturescape/Provincal_Guide_2003.pdf

97 See http://www.stewardshipcentre.bc.ca/stewardshipcanada/

What Prospective Home Buyers Can Do

Home buyers can influence the building of new housing developments by choosing "green" developments, where there are:

- mixed neighbourhoods, with residential and commercial uses, resulting in less driving time;
- clusters of homes close to existing infrastructure and amenities, meaning there is less need to convert more natural habitat to human uses;
- narrow access lanes with swales, porous surfaces and ditching rather than a "pipe and pave" system;
- re-development within areas already converted to other uses; and
- natural habitats left undisturbed, with minimal area cleared for lawns and other non-native vegetation.

"The real wildlife managers are the land owners." – Wildlife Habitat Canada

Prospective home buyers can learn more by reviewing the Stewardship Series publication entitled *Community Greenways: Linking Communities to Country, and People to Nature* available on-line through the Stewardship Centre for BC website.

A British Columbia realty business (http://www.greenerhomes.ca) believes that realtors can, should, and now are, playing a significant role in addressing the health, energy-efficiency and environmental impacts of our homes[98]. Green Realtor training and certification is being developed by the Greener Realty of BC Association and its partners. The fields of study include pollution, contamination, and site and community planning, including protective covenants.

If You Choose to Develop

Many land owners are faced with the difficult decision of developing their properties to offset the burden of property taxes. There are reduced tax options to protect forest and agricultural lands, but little incentive for land owners to protect the natural and cultural features of their land. This sub-section will provide some guidance when developing private land; the following sub-section describes options to reduce taxes.

The Stewardship Centre for BC website[99] provides links to documents that give guidance on how to develop land and shorelines in a sustainable manner, and how to mitigate potential impacts. Developers should refer to the *Develop With Care* guidelines[100] published by the Ministry of Environment which can help minimize ecological impacts. These guidelines recommend:

- conducting a site inventory to gather available environmental information before designing the development;
- planning and designing the development to ensure community plan and conservation objectives are met and draw on local knowledge and expertise;

98 Land Trust Alliance of BC 2007

99 See http://www.stewardshipcentre.bc.ca/stewardshipcanada/

100 http://www.env.gov.bc.ca/wld/documents/bmp/devwithcare2006/develop_with_care_intro.html

- retaining and enhancing ecosystem features and functions including habitat connectivity, ecosystem restoration, and management of invasive species;
- protecting water quality and quantity by maintaining the natural hydrology;
- reducing the potential for hazards by managing for wildfires, spills and site contamination; and
- providing waste management for on-site sewage disposal and solid waste.

Join or Create a Stewardship Organization, Land Trust or Advocacy Group

People may first learn about sensitive ecosystems through the activities of a stewardship organization in their community. Generally, stewardship organizations and land trusts are non-profit and frequently non-political organizations dedicated to protecting specific sites, species, habitats, or sensitive ecosystems. These groups range from loose-knit "Friends of..." clubs to formal, registered charitable organizations like the Nature Conservancy of Canada.

Stewardship Organizations

Stewardship organizations include a broad spectrum of groups, both charitable and non-charitable, as well as formal and informal (see Appendix I for a list of stewardship organizations in the area). Typically, stewardship organizations are involved in hands-on management, protection, rehabilitation or enhancement of habitat. Some stewardship organizations may hold ***conservation covenants*** on land. A conservation covenant is a voluntary, written legal agreement in which a land owner promises to protect their land in specific ways pursuant to Section 219 of the *Land Title Act*.

Stewardship organizations raise public interest and awareness about natural areas and sensitive ecosystems through a number of means: hosting festivals; distributing native plants[101], holding public information and education sessions; and weed removal days, among other activities.

If there is not a suitable organization in your area already think about starting one. A helpful publication from the Stewardship Series is *Community Stewardship: A Guide to Establishing Your Own Group*[102].

Land Trusts

Land Trusts are not "trusts" in the legal sense but they fulfill a form of public trust by holding an interest in land, or owning land and preserving it for future generations. Land trusts have been active in Great Britain and the United States for more than 100 years. In Canada, they are a more recent phenomenon, but have been growing rapidly, particularly in British Columbia.

Like stewardship organizations, land trusts are committed to raising public interest and awareness of natural areas. They are private non-profit organizations

101 Native Plant Society of BC, http://www.npsbc.org/

102 Fraser Basin Management Program 1995. http://dev.stewardshipcanada.ca/sc_bc/stew_series/NSCbc_stewseries.asp

committed to the long-term or permanent protection of natural areas. Land trusts are usually registered charities, so donations of land or money are tax-deductible. A land trust may own land itself, or it may enter into conservation covenants with property owners to protect or restore natural or heritage features on the owner's land[103]. Although land trusts are independent non-government organizations, they frequently work in partnership with all levels of government, other organizations, businesses, and communities in achieving shared conservation goals[104].

There are several land trusts active in British Columbia. The largest and oldest land trust is an international organization, Ducks Unlimited. The Nature Conservancy of Canada is a national organization with significant activities in British Columbia. The province-wide group The Nature Trust of BC is focused mostly on habitat protection, whereas The Land Conservancy of BC focuses on protecting lands with both natural and cultural heritage values. There are 32 local land trusts and conservancies operating in communities across British Columbia.

Advocacy Groups

Stewardship organizations and land trusts are advocates for their causes but advocacy groups do not typically own land for conservation purposes or carry out stewardship activities. Advocacy groups focus on raising awareness, raising funds and informing public opinion to encourage the protection of sensitive environmental areas.

Advocacy groups can raise concerns and argue the case for protection for environmentally sensitive areas where a senior or local government has the authority to protect the area on private land but has made a decision not to do so.

Advocacy groups fill an important niche in sensitive ecosystem protection, by allowing stewardship organizations and land trusts to pursue their activities, unaligned with one position or another in any contested land use debate. Traditionally, support for advocacy groups comes from a small spectrum of committed members and donors that support the mission and strategies adopted by the organization.

Participate in Your Local Government

Making the significant commitment of running for a position in the local government may be a step very few people are willing to take. There are, however, other ways that land owners and citizens can participate in local land use decision-making.

Speaking at council meetings or public hearings, volunteering for appointment to a local government Environmental Advisory Committee or an Advisory Planning Commission, or offering expertise on an informal basis to these agencies, allows land owners and citizens to provide informed recommendations to Council on matters that are referred to the Committee or Commission.

103 Land Trust Alliance of BC 2007
104 See http://www.landtrustalliance.bc.ca

Get to know your local government directors and other elected representatives. These people have a responsibility to their electorate and your vote can influence the direction that future local land use will take.

Consider Legal Tools for the Long-term Protection of Natural Areas

Land trusts or stewardship organizations may be able to help land owners establish longer term and more secure means of protecting natural areas on their land. Some examples of legal tools for protecting natural areas on private land include stewardship agreements and conservation covenants.

Stewardship Agreements

Stewardship agreements are voluntary, mutual agreements between the land owner and a stewardship organization or land trust. The land owner agrees to maintain a natural area on their property and to encourage native vegetation and wildlife. The land trust or stewardship organization agrees to provide support and training to the land owner for natural area protection.

Stewardship agreements are not legal tools for land protection, they are handshake agreements only. Often the land owner is not yet prepared to adopt more permanent legal protection, such as a conservation covenant, that will restrict the uses of some or all of the land.

Conservation Covenants

A conservation covenant is also a voluntary, written agreement between a land owner and another person, or more typically, an organization, where the land owner undertakes to protect certain natural values of the land[105]. A conservation covenant provides stronger protection for natural areas than stewardship agreements because they give the land trust(s) an interest in the land. That interest is registered on the Land Title or property deed, and is binding on anyone who may own the land in the future.

Conservation covenants, known in other jurisdictions as conservation easements, have been used for more than a century to protect natural areas. Their chief advantage is that conservation objectives can be achieved by limiting the use of the land without eliminating all uses at significantly less cost than out-right purchase. Conservation covenants can be written to protect whatever feature or portion of the land that the land owner wishes.

A conservation covenant may provide tax advantages to the land owner. If it is shown that registration of a conservation covenant has reduced the property value through restrictions on its use (under the provisions of the *BC Assessment Act*), then the covenanting organization may provide the land owner with a

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105 Land Title Act, RSBC 1996 c. 250, section 219. Under the terms of the conservation covenant, the interest granted may allow public access or it may limit access to the land trust(s) for the sole purpose of monitoring the covenant. Holders of conservation covenants must be pre-approved by the Surveyor General of BC, on behalf of the Minister of Agriculture and Lands.

charitable receipt for the difference in the land value. The land owner has, in effect, made a charitable donation that provides a tax credit. This tax credit can be carried over several tax years to prolong the impact.[106]

Similarly, property taxes in British Columbia are a based on the "actual value", typically the market value,[107] of a parcel of land. If it can be demonstrated that the property value is reduced by the restrictions[108] of a registered conservation covenant then the land owner will have the benefit of reduced property taxes. The Land Trust Alliance of BC (2006) states that if BC Assessment is informed, the property assessment could be reduced if they consider it warranted and supported by market evidence. The study found that assessed land value can be reduced up to 50%, though most will be much less, probably in the 10 to 20% range. For those covenants that have only nominal impacts, there may be no adjustments. A covenant will have no impact on assessed property values for those properties classified entirely as farm land, as these lands are valued using regulated rates based on the production capabilities of that land as farm land.

Under the *Local Government Act* (1997), there are specific provisions for reducing property taxes in eligible riparian areas with covenants. Under the *Riparian Areas Regulation* (2006) the responsibility for riparian area protection falls to local governments, hence many land owners are seeking conservation covenants on riparian areas with both the local government and a land trust organization.

Conservation covenants require regular monitoring (usually annually) by the covenant holders. The land owner that initiated the conservation covenant may dispose of the land to those with different views about the land's intended use. In this event, threats to the covenanted natural area or feature may require more frequent monitoring to ensure its protection. A program of land owner contact and education is an important means of ensuring compliance with the objectives of the covenant without the land trust organization having to resort to a costly court action for enforcement[109].

Land trusts and stewardship organizations (if designated by the Ministry of Environment) are entitled to hold conservation covenants[110]. Holding covenants is less costly to the organizations than holding land, but there are costs: surveying the land, retaining a lawyer to draft the covenant, registering it on the title, and monitoring the covenanted area to ensure compliance. Additional costs of holding covenants include maintaining, building, and storing covenant archives.

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106 The tax considerations and the structuring of charitable gifts of land and interests in land can be complex depending on the circumstances of the land owner and on the nature of the gift. Competent tax advice is essential in order for the land owner to see the greatest benefit from their generosity.

107 As provided by the BC Assessment office.

108 Restrictions such as limited numbers of buildings and restrict placement of them, and no subdivision.

109 McPhee et al. 2000

110 Land Title Act, c. 250, section 219(3).

Other Interests in Land

Land ownership in British Columbia is akin to owning a bundle of rights to use and occupy land. As a human invention, there are consequently many creative methods of granting rights that may also provide protection of natural areas[111].

Land law can be complex. Land owners may receive valuable information and assistance from land trusts, stewardship organizations or advocacy groups in sorting through the options available to them for land protection, but ultimately land owners must assume the responsibility for defending their interests and realizing their wishes by seeking the advice of legal counsel[112]. The intent of this section is to inform the reader of other avenues for protection of land by the land owner.

Life Estate

A land owner may grant a life estate of the land to his or her children with the remainder given to a conservation organization. This means that the land owner gives the right to use and occupy the land to his or her children until their death. During their lifetime, the children are responsible for looking after the land and are restricted from diminishing the value of the land. After the death of the children, the conservation organization becomes the land owner.

Profit à Prendre

Profit à prendre is the ability of a land owner to grant an interest to someone to enter the land and remove something. This was used in earlier times to provide the rights to someone other than the land owner to remove hay or harvest trees on a property. For conservation purposes, however, a land owner could grant a *profit à prendre* to a conservation organization so that the conservation organization has the sole right to remove vegetation — a right it will never exercise. The land owner and any subsequent land owners would also be restricted from removing the trees or other vegetation[113]. Recent legal opinion suggests that these arrangements may not be effective conservation tools over the longer term, since if a *profit à prendre* is not used it may lapse and become void[114].

Donate Land

Land owners may take the ultimate step to secure legal protection for a natural area by donating land to a land trust, stewardship organization or government by deed or by will. To ensure the continued protection of the land if the organization ceases to exist or if the government does not honour the intent of the gift, the land owner could be advised to consider an additional land trust or organization to co-hold a conservation covenant. This is often referred to as

111 McPhee et al. 2000
112 McPhee et al. 2000
113 McPhee et al. 2000
114 Scull, pers. comm.2007

cross-covenanting. A local land trust or charitable conservation organization may hold the conservation covenant but it is recommended an alternative land trust or other organization be specified should the local group dissolve[115].

Tax Advantages

When considering a donation of environmentally sensitive land, land owners have two choices. Property can be donated as a capital gift or an Ecological Gift (see Ecological Gifts Program, below). Each has different tax advantages for donors. Issues such as capital gains, gifts of "ecologically significant lands" and other issues require land owners to seek the advice of a tax expert to pursue the best options for their particular circumstances[116].

A very helpful publication for general information on legal tools available to a land owner from the Stewardship Series is *Stewardship Options For Private Landowners in British Columbia* [117]. For even greater detail on the options available to land owners see Findlay and Hillyer (1994).

Under the *Local Government Act* [118]and the *Community Charter*[119], a registered non-profit organization (such as a land trust) that holds land in trust can be exempted from property taxes, with two main caveats: the activities of the non-profit on the land provide demonstrable benefit to the surrounding community; and that the regional district's board of directors permits the tax exemption at their own discretion (see The Land Trust Alliance of BC 2006).

Make a Charitable Donation

In addition to donating land or an interest in land, land owners and citizens may donate cash, goods and services, or leave money in a will to an organization dedicated to protecting natural areas and sensitive ecosystems. Most land trusts, stewardship organizations and advocacy groups are dependent upon the support of private donations, and the volunteer services of their members. To these organizations, no gift is too small, whether monetary or volunteer time, every contribution helps to protect natural areas.

Green Legacies

Green Legacies: A Donor's Guide for BC[120] is an excellent resource for conservation giving in BC[121]. Green Legacies are gifts made by the people of British Columbia to nature conservation organizations in the form of money, bequests, life insurance policies, land, and covenants. Green legacies provide a means to supplement the funding of important community services such as stewardship, habitat restoration, education, research, and more.

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115 McPhee et al. 2000
116 Hillyer and Atkins 2004
117 Ministry of Environment, Lands and Parks 1996
118 Sections 809(3) and (4)(a) of the Local Government Act are both relevant.
119 Section 224(2)(a) and 224(4) of the Community Charter apply.
120 See http://www.greenlegacies.ca/
121 Ministry of Environment, Lands and Parks 2002

The green legacies guide was developed by conservation organizations wanting to effectively connect donors interested in conservation with organizations needing support. The guide provides information and professional advice about different options for planned giving and the many organizations that can benefit.

Ecological Gifts Program

Protecting private land through land donation or designation of a conservation covenant is limited by financial considerations and concerns of private property owners over regulation of their land. As of May 2006, the federal Ecological Gifts Program (EGP) enables land owners to protect their land and not be subject to serious financial losses.

The EGP program provides a way for Canadians to protect their natural areas and leave a legacy for future generations. The Government of Canada has eliminated the tax on capital gains for all certified ecological gift donations made as of May 2, 2006. An ecological gift is a donation of ecologically sensitive land or a partial interest in land that meets certain conditions under the *Income Tax Act*. Ecological gifts can be made to environmental charities[122] approved by Environment Canada, or to any level of government in Canada. Under the EGP, Environment Canada certifies the land is ecologically sensitive, approves the recipient of the gift, and certifies the fair market value of the gift (http://www.cws-scf.ec.gc.ca/egp-pde/)[123].

122 Land trusts, Stewardship Organizations, or other federally approved groups.
123 In British Columbia, the coordinator of the Ecological Gifts Program can be reached at (604) 940-4700.

22 What Senior Governments Can Do

This section provides an introduction to the provincial and federal legislation that may be used to protect sensitive and other important ecosystems in the SEI study area. The Government of Canada and the Province of British Columbia have a responsibility to protect and manage the environment using legislated powers. Some legislation is directed at specific resources such as the federal *Fisheries Act* and the provincial *Fish Protection, Wildlife* and *Water Acts*, whereas others address broader environmental issues through assessment or process requirements.

In general, wetlands and riparian ecosystems are most effectively protected under federal or provincial laws (e.g., *Federal Fisheries Act, BC Water Act, BC Fish Protection Act*). Forested ecosystems on provincial Crown land are also afforded considerable management emphasis under the *Forest and Range Practices Act* and those on managed forest lands are subject to the *Private Land Forest Practices Regulation*. However, there are few provisions aimed specifically at maintaining or protecting forested ecosystems elsewhere. Other SEI ecosystem types including grassland, broadleaf woodlands, and sparsely vegetated ecosystems have fewer legislative policies or laws available for their protection, although the *Wildlife Act* and the *Fisheries Act* can be used for some of these ecosystems in certain circumstances.

The paramountcy principle under the Canadian Constitution, gives more senior levels of government powers over lower levels of government, therefore the Parliament of Canada has and uses powers that supersede provincial and local government powers. Provincial powers that override local powers are usually stated as such in legislation. Another principle — 'occupied field' — means that where a higher order of government does not use its powers and the lower level chooses to do so under its legislation, it may do so even if primary jurisdiction rests at a higher level.

Some of the strongest legislation for environmental protection is the responsibility of the Government of Canada and Province of British Columbia. However, the provincial government has primary jurisdiction over land use decisions. As well, Fisheries and Oceans Canada, Environment Canada, BC Ministry of Environment, BC Ministry of Agriculture and Lands, BC Ministry of Forests and Range and BC Integrated Land Management Bureau have expertise, information and other resources that may be useful in identifying and conserving sensitive ecosystems.

Federal Legislation

Federal Crown Land

In general, provincial and local land use regulations do not apply to land that is within federal jurisdiction. This includes certain airports, Department of Defence lands, federal institutions, and other federally owned lands. It also includes land occupied by tenants, but owned by the federal government.

Canada Wildlife Act

Canada Wildlife Act enables the federal government to do wildlife research and interpretation and to designate National Wildlife Areas (NWA) for conservation purposes. One of the five NWAs in British Columbia is in the SEI study area—the Vaseaux – Bighorn NWA.

Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act

The purpose of this Act is to protect designated species of animals and plants by regulating international and interprovincial trade in them. It creates an offence to export from Canada, transport from one province to another, or possess an imported or transported animal or plant, or part thereof, except with a permit. This Act and regulation is intended to implement the Convention on International Trade in Endangered Species of Wild Fauna and Flora as ratified by Canada on April 10, 1975. It recognizes endangered and threatened species in Canada.

Migratory Birds Convention Act

This Act is primarily concerned with regulating the hunting and use of migratory birds in Canada. Regulations pursuant to the Act restrict the disturbance or destruction of nests, eggs and shelters of migratory birds, except in accordance with a permit. Likewise, no person or vessel may deposit a substance that is harmful to migratory birds in waters or areas frequented by migratory birds. One of the seven Migratory Bird Sanctuaries in British Columbia is located in the SEI study area: Vaseaux Lake Migratory Bird Sanctuary.

Fisheries Act

The Federal government regulates Canada's fisheries and is responsible for protecting fish and fish habitat. Fish habitat means spawning grounds and nursery, rearing, food supply and migration areas on which fish depend. This definition encompasses most streams, rivers, wetlands, and riparian areas in which fish live. All of these habitats may be found in the SEI ecosystem types.

The *Fisheries Act* prohibits anyone from undertaking activities that cause the harmful alteration, disruption or destruction of fish habitat unless authorized by a permit. In addition, no one may deposit any deleterious substances in water frequented by fish. Development in and around streams in the SEI area is subject to the provincial Riparian Areas Regulation process (see below) under which registered professionals assess the federal *Fisheries Act* requirements and

recommend mitigation and replacement for the unavoidable destruction of fish habitat.

Canadian Environmental Assessment Act

The *Canadian Environmental Assessment Act* (CEAA) establishes standards for conducting environmental assessment of projects that have the potential to affect the environment prior to approval. Projects include physical works and activities listed in the Inclusion List Regulation. CEAA can be triggered when a federal authority:

- Provides authorization, such as a permit, licence or approval under the Law List Regulation for a project;
- Sells, leases or transfers control or administration of federal lands for the project;
- Provides federal funding for a project; or
- Proposes a project.

The Exclusion List Regulations sets out a long list of projects that are exempt from an environmental assessment because the federal government deems them to likely have insignificant environmental effects. For example, these include the maintenance or repair of existing physical works.

There are four different types of environmental assessment - screenings, comprehensive studies, mediations and review panels. A screening documents the environmental effects of a proposed project and determines the need to mitigate those effects, modify the project, or recommend further assessment. If the project needs further review, the Minister of Environment may refer the project to a mediator or a review panel. Large-scale projects, such as oil and natural gas development, industrial plants and certain project in national parks, are listed in the Comprehensive Study List Regulation and require a comprehensive study.

Because of federal responsibility under the *Fisheries Act*, wetland and riparian ecosystems are the most likely ecosystem types to be affected by CEAA. The *Fisheries Act* will be the most significant trigger for the CEAA in the SEI study area, and most of these are addressed at a regional level with some opportunity for public review and comment.

The provincial BC *Environmental Assessment Act* (BCEAA, see below) sets out a provincial environmental assessment process that has a similar purpose to CEAA. There is a harmonization agreement between the federal and provincial governments to reduce overlap between the two processes. If a project triggers both CEAA and BCEAA, then the BCEAA process is used to address CEAA requirements, with outstanding federal issues addressed by CEAA.

The federal government uses the SEI in the CEAA process to identify areas of concern. For example, the Canadian Wildlife Service will provide expert advice to a responsible authority under CEAA recommending that project impacts to SEI sites be avoided or minimized.

Species At Risk Act (Canada)

The *Species At Risk Act* (*SARA*) is federal legislation that aims to prevent wildlife species from being extirpated or becoming extinct, and to provide for the recovery of wildlife species that are listed as at risk. *SARA* establishes processes for identifying extirpated, endangered and threatened species, and for adopting recovery plans for those species. It also contains a number of prohibitions, such as against killing or destroying the habitat of an at-risk species. Wildlife species include both plants and animals.

Species identification and recovery processes include:

- **Listing species** as extirpated, endangered and threatened. This process is undertaken by the appointed non-government Committee on the Status of Endangered Wildlife in Canada;
- **Preparing a mandatory recovery strategy** if a wildlife species is listed as extirpated, endangered or threatened. The Minister who is responsible for preparing the recovery strategy may adopt a multi-species or ecosystem approach;
- **Protecting critical habitat** by regulation, agreement or a general prohibition against destroying critical habitat, if a recovery strategy or action plan has identified critical habitat;
- **Preparing management plans** for species of special concern;
- **Issuing emergency orders** to provide for the protection of listed species if species face imminent threats to survival or recovery; and
- **Maintaining a public registry** where listed species, status reports on listed species, recovery plans, and national codes of practice are available (see http://www.sararegistry.gc.ca/).

Protected habitat in B.C. under the Migratory Birds Convention Act 1994 includes the following bird sanctuaries: Christie Islet, Esquimalt Lagoon, Nechako River, Reifel, Shoal Harbour, Vaseux Lake, and Victoria Harbour.

While *SARA* binds the governments of Canada and the provinces, its scope is limited in B.C. because most land in the province is held by the provincial Crown. *SARA* applies for mainly to two types of land: federal land, such as national parks; and to the critical habitat of aquatic species and migratory birds protected by the *Migratory Birds Convention Act 1994*. Protection of aquatic species is limited to coastal and inland waters over which Canada has authority. In some cases *SARA* applies to Indian Reserves.

Finally, Cabinet, on recommendation by the Minister, may make an order that no person shall destroy any part of the critical habitat of a listed endangered species or a listed threatened species that is in a province or territory. The Minister may make this recommendation if a provincial minister has requested it, and must make this recommendation if the Minister is of the opinion that the laws of the province do not effectively protect the critical habitat. In addition, the Minister may designate areas of federal lands on which a provincially listed endangered species is protected.

While the federal government has posted recovery strategies for 30 percent of the BC species listed as threatened or endangered, it has not identified critical habitat on any private lands or lands owned by a local government.[124]

124 Green Bylaws Toolkit 2007.

International Trade and Investment

The federal government has exclusive jurisdiction over trade and commerce. Under this authority, the federal government entered the North American Free Trade Agreement (NAFTA) with the United States and Mexico. Some provisions of NAFTA have significant and ominous implications for land use management and conservation. Chapter 11 of the Agreement entitles foreign investors from the US and Mexico to compensation if land use regulations are ruled as "tantamount to expropriation." In one case, a Mexican land use regulation blocking a planned hazardous waste landfill led to a large payment of compensation to a US firm. Buholzer (2001) argued that,

> *"Had this agreement been in effect in 1973 when the Agricultural Land Reserve ("ALR") was established, investors from Mexico and the U.S. who purchased agricultural land with plans to develop it for uses that are not permitted in the ALR would have been entitled to compensation, though Canadian investors would not. It seems that Canada may now have reason to discourage provincial governments, and their municipalities, from taking legislative measures that, despite their desirability domestically, might be 'tantamount to expropriation' and result in a claim against Canada for compensation."*

First Nations

First Nations Role in Conserving Sensitive Ecosystems

Sensitive ecosystems occur within First Nations' reserve boundaries as well as their traditional territories. The authority to manage these ecosystems derives from the *Indian Act*, *First Nations Land Management Act*, court cases concerning aboriginal title, treaties negotiated with federal and provincial governments, and other co-management or interim agreements between federal and provincial governments.

The *Indian Act* grants the majority of governmental power over lands and resources on reserve lands to the Minister of Indian Affairs, the Governor-in- Council and other government officers. First Nation bands have only very limited authority to make decisions regarding the use of some natural resource activities on reserve. For example, the Band may make regulations in relation to fur-bearing animals or fish on reserves. In most other cases, authority rests with the Minister or other department officials. The Minister or other official has authority to govern mining, grant timber permits, or deal with waste disposal on reserves. In addition to the *Indian Act*, the *Indian Oil and Gas Act*, *Fisheries Act*, and *Migratory Bird Convention and Act* also deal with natural resource issues on reserves.

In 1997 the Supreme Court of Canada decision in the Delgamuukw case confirmed that aboriginal title to land was never extinguished in BC. This decision expanded the definition of aboriginal title beyond the right to traditional use of the land to include the right to exclusive use and occupation of the land, commonly held property interests, and the right to non-traditional use of the

land (BC Treaty Commission). Inherent in the definition of aboriginal title is the protection of natural values. Aboriginal title is based on First Nations relationship with the land that has evolved over time with traditional uses such as hunting, fishing and gathering. Development or any other activities that would exclude or destroy the opportunities for future generations to participate in traditional activities are not permitted[125].

First Nations involved in the treaty process can enter into co-management agreements with federal and provincial government agencies in which they become active participants in land management decisions for the area. This allows First Nations to protect their interests until a treaty process is concluded.

There is a movement away from the *Indian Act* to self-government among First Nations. The *First Nations Land Management Act*, passed in 1999 gives Bands more local control over management of reserve land and their ecological values[126]. This Act applies to the following First Nation groups in B.C.: Squamish, Musqueam, Lheidli T'enneh, N'Quatqua, and Westbank. Under this Act, Bands have agreed to develop their own Land Code that replaces the land management sections of the *Indian Act*.

When a Land Code is adopted, environmental protection at the local level rests with each band and will be determined by the management strategies defined for their reserve. This is asserted through their authority to enact laws respecting the regulation, control or prohibition of land use and development including zoning and subdivision control, environmental assessment and environmental protection, management of natural resources on their land, and the enactment of laws relating to development, conservation, protection, and management[127].

First Nations have the authority to assert environmental control at the local level over reserve lands leased from Indian and Northern Affairs Canada to a developer. When head leases are negotiated with a developer a band can assert zoning and bylaw regulations over the development process. This can ensure development will fit in with conservation priorities defined for the reserve.

Although not required to by law, First Nations and neighbouring municipalities can set up formal avenues for communication and collaboration in land management planning decisions. In this way, rather than acting as isolated bodies on a contiguous landscape when land management plans are developed, planning can be complementary between the local government and First Nation.

When First Nations have a legitimate claim to an area and are involved in the treaty negotiation process their interests and the natural values in these areas can be protected through co-management agreements between themselves and other levels of government until their claim has been resolved. Co-management agreements are also referred to as interim measurement agreements, memorandums of understanding, or park management agreements[128].

125 Clogg 1999
126 Adams 1999
127 Adams 1999
128 Clogg 1999

Traditional ecological knowledge developed by First Nations is another valuable tool for the conservation of sensitive ecosystems. This body of knowledge is the result of First Nations close relationship with the ecological, cultural and spiritual values of the landscape. This kind of knowledge "includes understandings of plants and animals (properties or locations), the functioning and management of ecosystems, and the reliance on species for food, medicines, fuel, or shelter"[129].

Provincial Legislation

Provincial Crown Land

While the provincial government owns some 94 percent of the land base of British Columbia and has a proprietary and constitutional right to manage these lands, this jurisdiction is subject to the aboriginal rights and title of First Nations. Local government regulation addressing the use and development of land is not binding on the provincial government or its agencies. This means that OCPs and zoning bylaws are not binding on the Province. This immunity of provincial agencies from local regulation extends to certain Crown corporations, such as BC Hydro. However, the courts have recently ruled that local regulations do apply to tenants on provincial Crown land, for activities such as docks and processing of natural resources.

Local Government Act

Local governments, such as regional districts and municipalities, have authority over land use planning and development on private land in most of the province. Municipalities are incorporated cities, districts, towns, and villages. Regional districts are composed of municipalities and unincorporated electoral areas. They are the agencies with the greatest potential to implement SEI conservation guidelines in areas facing human development pressures because they can control how development occurs.

However, local governments have no authority to regulate use or development on federal land, including National Parks, Indian Reserves (except servicing by agreement) and Department of National Defense lands, or on provincial land (see above). Local government regulation of land use is also significantly curtailed on land in the agricultural land reserve, which comprises almost 5% of the province (see *Agricultural Land Commission Act* below).

The following considerations are important when looking to local governments to protect environmentally sensitive areas:

- Local governments have an extensive list of land use planning and land conservation tools available to them under the *Local Government Act* and *Community Charter*. Most local governments do not use the full extent of the legislation to protect SEI values.

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- Most land development and servicing decisions made by a local government can incorporate ecosystem restoration, maintenance and enhancement practices. Indeed, several local governments have in-house environmental assessment or review processes to assess the environmental impact of new developments and municipal projects.
- Local governments often have several different ways in which they can accomplish the same land conservation goal. For example, avoiding development on an ecologically sensitive portion of a parcel can be achieved through zoning, development permits, environmental bylaws and/or dedication of part of the subdivision.
- Local governments do not have to compensate land owners for differences in the value of land that result from zoning changes. No compensation is due if a local government decision decreases the amount of development allowed on a parcel of land to maintain conservation values. However, compensation will be payable to a landowner if a local government restricts the use of land to a public use (e.g. a park) or "sterilizes" the use of the land so no use of the land is allowed.
- Under the *Local Government Act* and *Community Charter* (see below) there are important differences in the regulatory powers of municipalities and regional districts.
- The environmental protection mandate is one of several priorities for local governments that include housing, economic development, transportation, crime, health, and quality of life. The extent to which locally elected representatives champion ecosystem protection reflects the values and priorities of the community.

See the Green Bylaws Toolkit for a comprehensive overview of local government jurisdiction for protection of sensitive ecosystems – www.greenbylaws.ca

Part 25 of the *Local Government Act* sets out the purpose and process for developing regional growth strategies, which are consensus-based plans aimed at addressing growth management and other regional-scale issues. Urban containment and environmental protection are key components of any regional growth strategy.

Part 26 of the *Local Government Act* gives local governments authority to regulate the planning and development of land. They can regulate uses in different areas (zoning), set minimum lot sizes, implement landscaping and subdivision servicing bylaws, and define development permit areas for the protection of the natural environment.

Community Charter

The *Community Charter* (*Charter*) came into force on January 1, 2004 and establishes a new regime of municipal authority in B.C. The *Charter* is intended to grant municipalities broader powers so they have flexibility to determine the pubic interest and to respond to the needs and changing circumstances of their communities. The *Charter* addresses the regulatory and administrative powers of municipalities and does not change the existing land use planning regime. Parts 25 and 26 of the *Local Government Act* dealing with regional growth strategies, official community plans, and other land development tools are still valid.

The *Charter* does not apply to regional districts unless stated in the *Charter* or another piece of legislation. The *Charter* grants municipalities the ability to protect sensitive ecosystems in two ways, by regulating trees and protecting the natural environment. Tree bylaws that prohibit and regulate tree cutting and the treatment of trees do not apply to land where forestry is occurring and must permit development on a parcel to the extent allowed by the zoning bylaw.

The provincial government views protection of the natural environment as a matter of provincial interest and has retained concurrent jurisdiction with municipalities in this area. This means that a municipality may only regulate with respect to environmental quality if it obtains the approval of the minister, does so under an agreement with the minister, or does so according to a regulation. In practice a municipality may pass bylaws regulating the cutting of trees without permission from the province. However, any other environmental protection authority not explicitly granted by the *Charter* or *Local Government Act* requires permission or regulatory authority from the province.

The province has granted additional environmental jurisdiction under the *Spheres of Concurrent Jurisdiction – Environment and Wildlife Regulation*. Municipalities may regulate and prohibit activities that obstruct or impede the flow of a watercourse, including a stream, creek or ditch. They may address the sale of wildflowers and the control and eradication of alien invasive species. Finally, they may regulate, prohibit and impose requirements in relation to the application of pesticides to outdoor plants on residential or municipal land for cosmetic purposes.

See Spheres of Concurrent Jurisdiction – Environment and Wildlife Regulation, http://www.qp.gov.bc.ca/statreg/reg/C/CommuCharter/144_2004.htm

Water Act

The *Water Act* and *Water Regulation* oversee the use of surface water and changes to streams and their banks. An application for the right to use water is assessed on a "first in time, first in right" basis for each water body. The province considers a number of factors when reviewing applications for water licenses, including the amount of water available and ecosystem needs such as for fish.

The *Water Act* also restricts activities that alter a water body, such as constructing works across a stream. A person making a change in and about streams must obtain a permit and must not adversely impact the stream by, for example, permitting a harmful substance to enter the stream or removing vegetation that contributes to stream channel stability. Changes in and about a stream means any modification to the nature of a stream, including the land, vegetation and natural environment in the riparian area. The *Water Regulation* enables habitat officers and other staff to impose conditions on the timing of construction, what material may be removed from the stream, the protection of vegetation and restoration. Water licenses contain approval for works in and about streams, such as diverting, storing and carrying water associated with the use of a water license.

"Changes in and about a stream" means any modification to the nature of a stream including the land, vegetation, natural environment or flow of water within a stream, or any activity or construction within the stream channel that has or may have an impact on a stream.

The new *Groundwater Protection Regulation* establishes a code of practice for constructing, maintaining and closing wells in the province. It does not address the use of groundwater. The Ministry of Environment makes decisions on licenses for water extraction and approvals for works in and about streams;

however, the applications are made through Front Counter BC of the Integrated Land Management Bureau, Ministry of Agriculture and Land.

Wildlife Act

The main focus of the *Wildlife Act* is to establish license regimes and acceptable practices for hunting, trapping and fishing in B.C. There are three wildlife protection and conservation mechanisms under the *Wildlife Act*: creating provincial Wildlife Management Areas (WMA), designating endangered and threatened species, and prohibiting disturbances of specific species and wildlife habitat. In addition, the *Act* creates the Habitat Conservation Trust Foundation, funded from surcharges on licenses, whose purpose is to provide funding to conservation and habitat acquisition projects.

The Minister may designate WMAs on land that is under his or her jurisdiction and that is not in a park, conservancy or recreation area. Land and resources in a WMA may not be used without the written permission of the regional manager in that area. The Minister may designate critical wildlife areas for threatened and endangered species within a WMA. Cabinet may designate threatened and endangered species. Unlike the federal *Species At Risk Act*, once species are designated under the *Wildlife Act* there is no mandatory action that the government must take to protect the species. Instead, the *Wildlife Act* relies on deterrence through offence provisions that prohibit damage to wildlife habitat.

Designated endangered species under the *Wildlife Act* are the Vancouver Island marmot, burrowing owl, and white pelican; the threatened species is the sea otter. None of these species reside in the SEI study area. The only WMA near the SEI study is the South Okanagan WMA.

Offences under the *Wildlife Act* include:

- Hunting, taking, trapping, wounding or killing an endangered or threatened species;
- Damaging or destroying wildlife habitat;
- Placing a substance or product on wildlife habitat in a manner that is harmful to wildlife or its habitat;
- Disturbing a muskrat or beaver house or den, or a beaver dam (except by trappers and where drainage is threatened);
- Taking, injuring or destroying a bird, its egg, or a nest when it is occupied by a bird or egg; and
- Taking, injuring of destroying the nest of an eagle, peregrine falcon, gyrefalcon, osprey, heron or burrowing owl.

Fish Protection Act

The purpose of the *Fish Protection Act* is to protect the ecological conditions in watercourses that sustain fish populations. This is accomplished by:

- Prohibiting the construction of new dams on listed protected rivers;
- Designating sensitive streams where fish populations are at risk because of inadequate flows of water within the stream or degradation of fish habitat.

Once designated, applications for water licenses in a designated stream may be subject to more rigorous information requirements and review;

- Developing recovery plans for sensitive streams; and
- Establishing policy directives for the protection of riparian areas subject to residential, commercial or industrial development (see discussion of *Riparian Areas Regulation* below).

Except where noted, the *Fish Protection Act* does not limit the authority of any public officer under the *Water Act*. However, the *Fish Protection Act* prevails when a conflict arises with the *Water Act*.

See Sensitive Streams Designation and Licensing Regulation, http://www.qp.gov.bc.ca/statreg/reg/F/FishProtect/89_2000.htm that designates streams for the purpose of protecting populations of fish whose sustainability is at risk because of inadequate flows of water or degradation of fish habitat. This regulation creates additional considerations for water license applications or other approvals on designated sensitive streams.

Riparian Areas Regulation

The *Riparian Areas Regulation* (*RAR*) replaced the *Streamside Protection Regulation* with a new approach to protecting riparian areas and the ecological conditions that support fish. The purpose of the regulation is to provide protection for the features, functions and conditions that are vital in the natural maintenance of stream health and productivity for fish populations when development is proposed. It is a one window approach for development approvals in riparian areas that implicate provincial jurisdiction and the federal *Fisheries Act*.

The *RAR* applies to local government application of planning and land use powers under the *Local Government Act*. The regulation outlines a two-pronged approach to designating and assessing the quality of riparian areas and the impact of activities in that area. A local government must not approve a development proposal or allow a development to proceed that is wholly or partially within a defined riparian area unless a qualified environmental professional has assessed the impact of the development and has either found that there will be no harmful effect, or where protection of the streamside protection and enhancement area and mitigation measures will ensure there is no harmful impact, to conditions that support fish life processes. The Ministry of Environment and Fisheries and Oceans Canada may also authorize harmful alteration or destruction of natural features and conditions that support fish life processes.

"Natural features, functions and conditions" include but are not limited to large organic debris that falls into a stream, floodplains, side channels, the multi-canopied forest and ground cover adjacent to streams, and permeable surfaces that permit infiltration to moderate water volume, timing and velocity, and maintain sustained water flows in streams.

Under the *Fish Protection Act* a local government must provide a level of protection that, in the opinion of the local government, is comparable to or exceeds that established by the *RAR*. Therefore, while *RAR* relies on a qualified professional to achieve riparian protection, a local government can meet or exceed that standard using any of its planning and regulatory powers. Many local governments are relying on zoning and development permitting to achieve the objectives established in *RAR*.

The *RAR* affects municipalities and regional districts in the areas to which it applies (roughly the southern one third of the province, excluding the three regional districts in the southeastern corner.

The *Riparian Areas Regulation* applies to the following regional districts and municipalities within them: Capital, Central Okanagan, Columbia-Shuswap, Comox-Strathcona, Cowichan Valley, Fraser Valley, Greater Vancouver,

Nanaimo, North Okanagan, Okanagan-Similkameen, Powell River, Squamish-Lillooet, Sunshine Coast, Thompson-Nicola, and the trust area under the *Islands Trust Act*.

Land Act

The *Land Act* enables the province, through the Integrated Land Management Bureau of the Ministry of Agriculture and Land, to manage, regulate, and dispose of Crown lands. Applicants seeking to purchase, occupy or obtain an easement over Crown land may be required to post or advertise public notice about the application. Other agencies may also review and comment on potential land transactions involving Crown land.

While privately owned land is not subject to the *Land Act*, the bed or shore of water bodies below the natural boundary are Crown land. Foreshore structures such as wharves and docks may be subject to the *Riparian Areas Regulation* (see above) and the local government, provincial and federal approvals required under it. In areas of the province not subject to the *Riparian Areas Regulation*, applications made through Front Counter BC of the Integrated Land Management Bureau, Ministry of Agriculture and Land require approval by the Ministry of Environment. Applications for foreshore structures may also require approval under the federal *Navigable Waters Protection Act* and *Fisheries Act*.

Forest and Range Practices Act

The *Forest and Range Practices Act* (FRPA) enacted in 2002 defines a new approach to forest management. Under the FRPA and its regulations, companies have the lead role in forest management, and the role of government agencies and the public is reduced. Government agencies no longer prescribe how to manage logging or protect environmental resources in the forest. Instead, under the FRPA's "results based" approach, companies manage logging and forest resources, subject to broad government objectives.

For example, the *Forest Planning and Practices Regulation* enumerates the government's objective for riparian areas as follows:

> *The objective set by government for water, fish, wildlife and biodiversity within riparian areas is, without unduly reducing the supply of timber from British Columbia's forests, to conserve, at the landscape level, the water quality, fish habitat, wildlife habitat and biodiversity associated with those riparian areas.*

Under the *FRPA* the key point of input for government agencies, local governments, First Nations, and the public are the broad forest stewardship plans (FSP), which are prepared by the forest company. Before approval of these five-year plans, the FSP must be available for public review and comment. In these plans, forest companies specify intended results or strategies for forest development units. They must be consistent with objectives set by government on several subjects including environmental resources, such as water, wildlife, biodiversity, existing old growth management areas, riparian and wetland areas, fish habitat, and watersheds.

The Government is obligated to approve an FSP if the plan conforms to the *FRPA*, the regulations and the standards, and the minister considers that the forest stewardship plan's results or strategies are likely to achieve the objectives set by government. Therefore, sensitive ecosystem issues are relevant to the extent that they are addressed in government objectives prior to the submission of an FSP. Once approved, the FSP provides the framework for managing operations of a company in a forest area. While site level logging and road plans were formerly the key point of intervention of government in protecting sensitive ecosystems and resources, they are now prepared by a registered professional forester employed by the company.

While under the FRPA a person must not carry out any forest activities that result in damage to the environment, exemptions are provided for people doing so in accordance with a plan or permit, or where the person does not know and could not reasonably be expected to know that because of weather conditions or site factors the activity would result in environmental damage. Otherwise, a company will be responsible for environmental damage from events such as landslides and debris torrents into streams if such damage fundamentally and adversely alters an ecosystem. Thus, while penalties for contraventions have been considerably increased, the scope of what is regulated has been reduced. The company's compliance with the FSP would provide a due diligence defense against charges of harming the environment.

Finally, under the Government Actions Regulation of the FRPA, various Ministers can designate a variety of zones where special management is warranted. Where other enactments do not offer adequate protection, the Ministers may establish:

- lakeshore management zones;
- scenic areas that are visually important based on physical characteristics and public use;
- community watersheds to conserve the quality, quantity and timing of water flow, or to prevent adverse cumulative hydrological affects;
- a general wildlife measure for a specific area, a category of species at risk, regionally important wildlife or specific ungulate species, if satisfied that the measure is necessary to protect or conserve the species in the category or area to which the measure relates;
- wildlife habitat areas or features if the areas or features are necessary to meet the habitat requirements of a category of species at risk or regionally important wildlife;
- ungulate winter range if the area contains habitat that is necessary to meet the winter habitat requirements for a category of specified ungulate species;
- categories identifying species of wildlife as species at risk if satisfied that the species are endangered, threatened or vulnerable;
- species of regionally important wildlife; and
- fisheries sensitive watersheds that have significant downstream fisheries values and significant watershed sensitivity.

For each of these special management areas the Minister may establish objectives that are consistent with the purpose of the special designation. The Minister has designated 85 endangered species, including the Great Basin Gopher Snake, Sage Thrasher, and Antelope Brush that occur within the SEI area. The Identified Wildlife Management Strategy sets out procedures for implementing landscape-level planning and special management practices for these species.

Private Managed Forest Land Act

In 2003, the *Private Managed Forest Land Act* replaced the *Forest Land Reserve Act* as the framework for managing forestry activities on private land. The object of the Private Managed Forest Land Council is to encourage forest management practices on private managed forest land, and to protect key public environmental values on private forest land. While owners are responsible for reforestation and forestry activities, the Council has responsibility for regulation, compliance and enforcement. The Council is empowered to make regulations respecting soil conservation, water quality and fish habitat.

All land that was private management forest before the *Act* came into force is deemed to continue as such. New land may be classified as private managed forest land when the Council accepts a management commitment from the owner. The owner is required to submit an annual declaration of the location and size of land where timber was harvested, roads built, and timber destroyed.

The *Act* establishes general land management objectives for private forest lands. These include soil productivity protection by minimizing roads and other excavation, and the retention of sufficient streamside mature trees and understory vegetation to protect natural variation in water temperature, sufficient cover for fish and large woody debris. The objectives also address the long term protection of critical wildlife habitat by giving a reasonable opportunity for provincial wildlife staff to assess whether critical wildlife habitat is present on private managed forest land, and to foster efforts of the government and owners to enter into agreements for the protection of critical wildlife habitat.

Under the *Private Managed Forest Land Regulation*, the minister responsible for wildlife is empowered to establish areas of private managed forest land as critical wildlife habitat if a species at risk is located on the land and the habitat is required for the survival of the species at risk because there is insufficient suitable habitat found on Crown lands within that ecoregion. The critical wildlife habitat must not exceed 1% of the total area of private managed forest land owned by that person and can only be designated for one year. Within areas of critical wildlife habitat an owner must modify road construction and timber harvest activities as required by the minister. The list of species at risk under the regulation contains 36 species of birds, plants, mammals, reptiles, amphibians and fish.

Local governments are prohibited from passing any bylaws that restrict a forest management activity, meaning private forest lands continue to be exempt from local government regulation when used principally for forestry. Privately managed forests comprise less than five percent of the provincial land base and

are concentrated on Vancouver Island. This number increased following the July 2004 provincial government announcement of the removal of extensive areas of private forestland from Tree Farm Licenses. Conditions attached to the removal include maintenance of certain wildlife habitats, maintenance of sustainable forest management certification, public and First Nations access, and planning for community watersheds.

Forest Certification

Forest management around the world is trending toward a certification approach. The certification approach effectively supplements existing forest legislation in many jurisdictions around the world, including BC. Consumers are demanding 'green,' environmentally friendly harvesting practices. Standards and criteria are being developed by various organizations to provide guidance to the certification process. These standards and criteria consider biodiversity and ecological functions and integrity, and ongoing consultation with local interests, among other things. Certification organizations have consulted with industry, environmental organizations, and the public in developing standards, and standards are evolving. Millions of hectares of BC forest areas have already been certified under various programs.

The Canadian Standards Association (www.csa.ca) organized the Canadian Sustainable Forestry Certification Coalition (www.sfms.com/csa), which developed a National Standard on Sustainable Forest Management (CAN/CSA Z809). The American Pulp and Paper Association organized the Sustainable Forestry Initiative (www.aboutsfi.org) in 1994. The SFI was founded to develop principles, standards and performance measures, and has disciplined substandard companies. The SFI has been used extensively in BC for certification. Another leader in developing this approach is the international Forest Stewardship Council (www.fsc.org), along with its Canadian (www.fsccanada.org) and BC (www.fsc-bc.org) affiliates. Membership includes forest companies, aboriginal, and environmental groups, such as the World Wildlife Fund. Monitoring, auditing, and certification processes are being organized to ensure quality control. Certification of forest products as environmentally friendly may ultimately be an essential requirement for doing business. Participation in certification organizations and consultation is thus one avenue for input to sensitive ecosystem management in forests.

Park Act

The *Park Act*, *Ecological Reserve Act*, and *Protected Areas of British Columbia Act* establish parks, ecological reserves, recreation areas and conservancies on provincial Crown land. Parks are divided into classes A, B and C, activities in which, particularly resource extraction, are restricted under the *Park Act*. Ecological reserves are designated areas for ecological purposes, such as scientific research, representative examples of natural ecosystems, and where rare or endangered native plants and animals in their native habitat may be preserved. Recreation areas are reserved for public recreation use. Finally, conservancies are a new category of Crown land set aside for the protection and

maintenance of biological diversity and natural environments, the preservation of social, ceremonial, and cultural uses of First Nations, and to ensure that development of natural resources within them is sustainable.

Recent amendments to the *Park Act* allow the Minister to enter into collaborative agreements relating to the administration and management of parks, conservancies and recreation areas, including wildlife and habitats. Parties contemplated in these agreements include local governments, First Nations and others. The Minister may also enter into agreements with First Nations regarding First Nation's exercising aboriginal rights and having access to land for social, ceremonial and cultural purposes in parks, conservancies and recreation areas.

Agricultural Land Commission Act

The province created the agricultural land reserve (ALR) in the mid-1970's to prevent the conversion of agricultural land to non-farm uses and to provide a stable land base to promote the farming industry. ALR lands are an important component of the green infrastructure in near-urban regions across the province, providing significant ecosystem benefits such as water retention, aquifer recharge, and habitat for migrating birds and other species.

The *Agricultural Land Commission Act* regulates the use of ALR land and limits local government land use planning authority in the ALR. This is accomplished by:

- **Defining lands included in the ALR** – owners and governments must apply to the provincial Agricultural Land Commission (the Commission) to include or exclude land from the ALR;
- **Restricting non-farm uses** – except where allowed by the Act, regulations or order of the Commission, a local government (including board of variance) must not permit agricultural land to be used for a non-farm unless the owner receives permission from the Commission for a non-farm use in the ALR; and
- **Restricting subdivision** – in general, an owner must apply to the Commission for permission to subdivide land in the ALR.

The *Agricultural Land Reserve Use, Subdivision and Procedure Regulation* details what is considered a farm use and allowed in the ALR. There are significant ecologically beneficial uses permitted in the ALR that local governments may not regulate, which include:

- biodiversity conservation, passive recreation, heritage, wildlife and scenery viewing;
- open land park established by a local government;
- ecological reserve established under the *Ecological Reserve Act* or by the *Protected Areas of British Columbia Act*;
- park established under the *Park Act* or by the *Protected Areas of British Columbia Act*;
- protected area established under the *Environment and Land Use Act*;
- wildlife management area established under the *Wildlife Act*; and
- recreation reserve established under the *Land Act*.

Farm Practices Protection (Right to Farm) Act

The *Farm Practices Protection Act* (*FPPA*) safeguards the right of farmers to farm in the agricultural land reserve in three ways. First, the *FPPA* states that a farmer must not be prevented from farming because of the nuisance impacts (such as odour and noise) of farm activities on others. This prevents neighbours from stopping farm operations by commencing court proceedings about nuisance, causing costly delays to season-dependent farm activities. To qualify for this protection, a farmer must use normal farm practices (see sidebar) in the agricultural land reserve, and must not contravene the *Health Act*, *Integrated Pest Management Act*, *Environmental Management Act*, the regulations under those Acts or any land use regulation.

Second, the *FPPA* states that normal farm practices do not contravene local government bylaws that address matters such as firearms, animals, nuisances, and disturbances. This prevents a local government from using local regulation to interfere with normal farm practices.

Third, the *FPPA* provides a process by which those with complaints about nuisances from farm practices can write to a farm practices board for a determination as to whether the disturbance results from normal farm practices. If the farm practice that is causing the nuisance is found by the board not to be a normal farm practice it will not be protected by the *FPPA* and the complainant can then take civil action (such as in the courts) to stop the nuisance.

Definition of Normal Farming Practices

A practice that is conducted by a farm business in a manner consistent with proper and accepted customs and standards as established and followed by similar farm businesses under similar circumstances, and any standards prescribed by regulation. This includes a practice that makes use of innovative technology in a manner consistent with proper advanced farm management practices and with any standards prescribed by regulation.

Weed Control Act

The purpose of the *Weed Control Act* is to prevent the spread and infestation of noxious weeds in the province. It requires occupiers of land to control noxious weeds and their seeds. The minister or a local government may appoint inspectors to inspect land and property, and they may issue notices directing an occupier to control noxious weeds. If the weeds are not controlled in the time or manner specified in the notice, or if immediate action is warranted, the inspector may control the noxious weeds and recover the cost of dealing with the weeds from the occupier of the land.

The *Weed Control Regulation* designates certain plants as noxious weeds on both a province-wide and regional basis. Designated plants include Spotted Knapweed, Leafy Spurge and Wild Oats. The *Weed Control Regulation* also addresses the transportation and sowing of screenings (seeds and other material removed in the process of cleaning or grading cereal, forage or oilseed crops), grain and other substances that may contain noxious weeds.

Environmental Assessment Act

The *Environmental Assessment Act* (*BCEEA*) establishes a process by which large scale projects with potentially significant environmental impact may be reviewed. The environmental assessment can identify the impacts of proposed projects on sensitive ecosystems and recommend mitigation measures for managing those impacts. A joint *BCEAA* and federal *CEAA* process may be undertaken through one process.

The *BCEAA* requires proponents of reviewable projects to obtain an environmental assessment certificate before proceeding. It is the executive director of the Environmental Assessment Office who determines whether or not a reviewable project will need to undergo an assessment, and what the scope of that assessment will be. The executive director considers a project's potential for significant adverse environmental, economic, social, heritage or health effect, taking into account practical means of preventing or reducing to an acceptable level the adverse effects of the project. Reviewable projects are designated by regulation and include categories of industrial, energy, mine, water management, waste disposal, food processing, transportation, and tourist destination resort projects. The Minister may also designate specific projects for review, or a project proponent may request a review.

The *Reviewable Projects Regulation* establishes different thresholds related to the size of the project that will trigger the assessment process. Reviewable projects may include manufacturing facilities, cement plants, pulp and paper facilities, mines including sand and gravel pits, power lines, pipelines, water diversion projects, groundwater extraction projects, shoreline modification, solid and liquid waste management facilities, highways, marine port facilities, and resort developments.

The Environmental Assessment Office refers an assessment report, recommendations, and reasons for the recommendations to the minister(s) who are responsible for granting or refusing to issue environmental assessment certificates.

23 Conclusion

Responsibility for the conservation and management of sensitive ecosystems does not fall under the jurisdiction of a single level of government. Rather conservation of sensitive ecosystems is the responsibility of all individuals, including members of senior and local governments, private landowners, developers and the general public. In order for effective conservation to occur in the Okanagan Valley there must be increased knowledge and support for conservation initiatives.

This inventory demonstrates that almost half of the landscape in the study area is sensitive ecosystems. Most of these have been altered or disturbed to some degree by impacts such as logging, forest ingrowth, draining and ditching of wetlands and introduced species invasions. Furthermore, there has been up to 90% loss of these ecosystems since 1800. With increasing pressures from growing populations and urban development, it is critical that the remaining sensitive ecosystems be retained in their natural state.

This document is intended to raise awareness of the presence of sensitive ecosystems in the Okanagan Valley and to demonstrate the pressures these ecosystems face. This report provides land managers, developers and private landowners with knowledge and some of the tools available towards ecosystem conservation and sustainable development. It will take conscious decisions and positive action from all members of the Okanagan Valley communities to conserve the rich and valuable natural heritage of their area.

"The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land."
– Aldo Leopold

Glossary[130]

Aeolian: Carried and deposited by the wind.

Aerial photograph[131]: A photograph showing a horizontal view of the earth's surface. When viewed under a stereoscope, aerial photographs appear in three dimensions.

Alien plant: Plant or animal species not native to a specific area.

Anthropogenic[132]**:** Human influenced. Sites or ecosystems that have been altered by human activities such that their physical properties have been drastically changed (for example: gravel pits, housing developments, roads, orchards).

Aspect: The compass direction that a slope faces. Aspect is often described more broadly relative to the major cardinal directions (e.g. a slope facing south has a southerly or warm aspect, a north facing slope has a northerly or cool aspect).

Biodiversity: The variety of living organisms on the planet, and their ecological roles and the genetic diversity they contain[133].

Biogeoclimatic subzones[134]**:** The basic zonal unit of the biogeoclimatic ecosystem classification system in BC. Biogeoclimatic subzones are a geographic area within which the same vegetation occurs on climax sites that are primarily influenced by climate, topography and geology.

Bioterrain[135]**:** Terrain map that emphasizes elements of the landscape that are relevant to ecosystem processes and wildlife habitat such as soil moisture conditions, aspect, and vegetation characteristics. *See also* **terrain mapping**.

Blue-listed: Those indigenous species, subspecies or plant communities considered provincially vulnerable. *See also* **indigenous**.

Bunchgrass: Grasses where many stems grow in a close tuft; having a characteristic growth habit of forming a bunch; lacking stolons or rhizomes.

Capability: The greatest ability of a habitat in a natural successional stage to support the life requisites of an organism; the suitability is the current ability of the habitat to support the life requisites of an organism.

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130 terms and definitions are extracted or adapted from Dunster and Dunster (1996) unless otherwise noted

131 Resources Inventory Committee 1998

132 Resources Inventory Committee 1998

133 Wilcox 1984

134 Pojar *et al.* 1991

135 Resources Inventory Committee 1996

Chernozem[136]**:** Soils with an upper layer that is dark due to the accumulation of organic matter from grasses and forbs; these soils are characteristic of grasslands.

Climax stage: The final, self-replacing stage in plant succession that has a relatively stable species composition and persists for long periods of time in the absence of disturbance. In ecosystems with frequent low severity fire, fire results in few changes in the structure and organization of the ecosystem and it persists in a climax stage.

Cluster housing: a development technique or zoning strategy that involves grouping houses on smaller lots in one area of a development while preserving the remainder of the site for recreation, common open space or protection of environmentally sensitive areas.

Cones[137]**:** Mountains, hills or other landforms shaped like a cone, having relatively steep slopes and a pointed top.

Coniferous: A term applied to cone-bearing trees having needles or scale-like leaves, usually evergreen.

Conservation assessment: A standardized evaluation of the ecological value of an ecological community based on landscape context, size and condition.

Conservation covenant: A voluntary, written legal agreement in which a landowner commits to protect his/her land in specified ways as outlined in the covenant. A conservation covenant can cover all or part of a property. Covenants offer a way of protecting land for a variety of uses such as wildlife habitat, watershed protection, scenic values and historic preservation. The agreement is between the landowner and an organization such as The Land Conservancy or other group or government agency. Conservation covenants protect the land by giving the covenant holder the authority to assume the long-term responsibility for monitoring and enforcing the agreement. The covenant is attached to the title of the land, is registered in the Land Title Office, and binds future owners of the land to the terms established by the covenant.

COSEWIC: The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild Canadian species, subspecies and separate populations suspected of being at risk. All native mammals, birds, reptiles, amphibians, fish, molluscs, lepidopterans (butterflies and moths), vascular plants, mosses and lichens are included in its current mandate. Endangered denotes a species facing imminent extirpation or extinction. Threatened denotes a species likely to become endangered if limiting factors are not reversed. Special Concern denotes a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

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136 Soil Classification Working Group 1998
137 Resources Inventory Committee 1996

Deciduous: A term applied to trees or shrubs, most commonly broadleaf trees, which shed their leaves annually (note that some conifers such as larch are also deciduous).

Density bonusing: a planning technique designed to encourage medium and high density developments. A developer who opts for density bonusing receives more units in return for providing amenities such as underground parking, parkland, landscaping and preserving of natural heritage.

Deposition[138]**:** Accumulation of earth material resulting from naturally occurring physical, chemical or organic processes.

Disturbance: A discrete force that causes significant change in structure or composition of vegetation through human caused events such as cutting trees, driving vehicles off-road, grazing of domestic animals. For natural events such as fires and floods *see*: **Natural disturbances**.

Ecological communities: The vegetation group that occupies a specific site, including trees, shrubs, herbs and bryophytes. Ecological community tends to be influenced by soil type, topography, and climate. The Conservation Data Centre assesses this unit for conservation status.

Ecological processes: The actions or events that link organisms (including humans) and their environment, such as natural disturbance, successional development, nutrient cycling, productivity and decay.

Ecoprovince: In the Ecoregion Classification system[139], this is an area of consistent climate or oceanography, and physiography, of a size useful for provincial overview-planning. This study area lies in the Southern Interior Ecoprovince. Ecoprovinces are subdivided into Ecosections.

Ecosection: In the Ecoregion Classification system, this is an area with minor physiographic and macroclimatic or oceanographic differences[140]. Ecosections in the study area include, the Southern Okanogan Basin (SOB) Ecosection, the Southern Okanagan Highland (SOH) Ecosection, the Shuswap Basin (SHB) Ecosection, the Okanagan Range (OKR) Ecosection , the North Okanogan Basin (NOB) Ecosection and the North Okanogan Highland (NOH) Ecosection.

Ecosystem: A functional unit consisting of all the living organisms and abiotic (non-living) factors of a portion of the landscape, together with the processes that link them including nutrient cycling and energy flow. An ecosystem can be any size, but here we define them as a portion of the landscape with relatively uniform vegetation and soils[141].

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138 Resources Inventory Committee 1996
139 Demarchi 1996
140 Demarchi 1996
141 Pojar et al. 1991

Edge effect: The penetration of wind, light, and humidity that create differences in microclimate (air and soil temperature, wind, light, humidity), as well as sound, predation, and visibility, beyond and into vegetation bordering a zone of disturbance. This document specifically focuses on edge effects associated with human influences as opposed to the natural edge effects associated with the influence of one adjoining plant community upon the margin of another.

Endangered: A wildlife species or ecological community that is facing imminent extirpation or extinction.

Emergent vegetation:[142] Upright plants rooted in water or exposed to seasonal flooding that emerge above the water surface. Commonly includes rushes, cattails and some sedges in the study area.

Erosion: The loosening and removal of soil by running water, wind or glaciers.

Exfiltration gallery: A means of dispersing stormwater through a gravel-filled trench or drywell.

Extinct: A species that no longer exists.

Extirpated: A wildlife species that no longer exists in the wild in Canada, but exists elsewhere.

Fan: A fan-shaped accumulation of materials deposited by a stream, river (see fluvial fan) or gravity with a slope of less than 26%.

Fire exclusion: The exclusion of fire from ecosystems. Fire suppression is the most widely known form of fire exclusion but the following factors also contribute to fire exclusion: cessation of First Nation's burning, reduction of fine fuels through grazing, removal of vegetation, and creation of roads and trails. See also **fire suppression**.

Fire regime[143]**:** A fire regime is a generalized description of the role fire plays in an ecosystem. Fire regime characteristics include fire frequency, extent, intensity, timing and the ecological effects of fire. A commonly used fire regime classification separates classes on the basis of the predominance of fires of a particular severity: low, moderate (or mixed) or high severity. See also **fire severity**.

Fire severity[144]**:** Fire severity refers to the effect of fire on the dominant overstory tree species in an ecosystem. Common classes of fire severity are low (few or no trees killed), moderate (many trees killed) or high (most or all trees killed).

Fire suppression: The prevention or extinguishment of natural or human-caused fires in ecosystems.

Fluvial[145]**:** Pertaining to streams and rivers.

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142 MacKenzie 2003
143 Agee 1993
144 Agee 1993
145 Resources Inventory Committee 1996

Fluvial fans[146]**:** A fan-shaped accumulation of materials deposited by a stream or river, usually at the point where a stream emerges from a canyon onto a plain.

Forage: The portion of vegetation (shrubs, grasses, forbs) that is available and can provide food for grazing or browsing animals (includes both domestic and wild animals). Also, the act of acquiring vegetation for food.

Forbs: Herbaceous plants with broad leaves, excluding grasses, sedges and rushes.

Forest encroachment: The establishment and growth of trees onto areas formerly dominated by grasses (grasslands). Forest encroachment is usually associated with **fire exclusion**.

Forest ingrowth: An abnormal increase in tree establishment in formerly open fire-adapted forests. Forest ingrowth is usually associated with **fire exclusion**.

Fragmentation: The breaking up of continuous areas of habitat into smaller parcels. For example ecosystems become fragmented when roads are built in them and when urban areas separate them.

Gleysols: Soils influenced by periodic or sustained water saturation as indicated by gleyed colours (dull yellowish, blue, or olive) or prominent mottles (reddish or orange spots or blotches).

Graminoid: Grasses, sedges, or rushes.

Grass: Plants in the family Gramineae, whose characteristics include stems that are jointed at nodes, are hollow, have sheathing leaves, and flowers (inflorescences) surrounded by bracts (glumes).

Grasscrete: A pervious reinforced concrete structure for trafficked areas that is either covered with grass, has grass growing in the voids of the structure or has stone in the voids of the structure.

Greenway: A system of protected linear corridors of green space, managed for conservation and recreation purposes.

Habitat: The natural abode of a plant or animal, including all biotic, climatic, and edaphic factors affecting life.

Habitat Conservation and Stewardship Program: A program of the federal Department of Stewardship and Oceans where Habitat Stewards (including one in the office of the Regional District of the Central Okanagan) work in partnership to protect and restore fish habitat.

Hazard tree: A tree or any component of a tree that has sufficient structural infirmity to be identified as having a high risk of falling and causing personal or property damage.

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146 Resources Inventory Committee 1996

Herbaceous: Plants that are herb-like and contain little permanent woody tissue. The above ground parts of the plant die back after the growing season. In annuals, the whole plant dies; in perennials the plant has organs (bulbs, corms or other structures) that survive beneath the soil in unfavourable conditions.

Hibernacula: Refuges (dens) from extreme conditions, usually during winter; generally applies to animals that undergo extended dormancy, such as reptiles and bats; these are usually specific sites and are used by countless generations (singular is hibernaculum).

Hydrological[147]**:** Water-related features and processes.

Hydrology[148]**:** The scientific study of the distribution and characteristics of water at and close to the earth's surface. This term is also used to refer to the movement of water into, within and out of an ecosystem.

Hydrophytic vegetation[149]**:** Any plants that are adapted for growing on permanently saturated soils deficient in oxygen.

Indigenous: Any native species growing naturally in an area or region.

Invasive alien plants: Non-native plants which lack the natural enemies necessary to restrict their distribution.

Invasive species: Native or alien species that were absent or represented in small numbers in the undisturbed landscape, that may invade or increase in numbers under certain circumstances, especially following disturbance. See also **invasive alien plant**.

Litter: The uppermost layer of organic debris on the soil surface which typically has not yet undergone significant decomposition.

Mottles: Reddish or orange spots or blotches in soils (typical of **gleysols**).

Natural Disturbance: An event that causes change in structure or composition of the ecosystem through natural events such as fire, flooding, wind storms, and insect outbreaks with minimal influence from human activity.

Noxious weed: Aggressive invading weeds that are designated under the provincial *Weed Control Act*. *See also* **weed**.

Organic soils[150]**:** Sediments formed by the accumulation of decaying vegetation matter; occur in some wetlands in the study area.

Overstory: The upper canopy of trees in a forest or woodland.

Patch: A spatially distinct unit of a particular habitat.

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147 Resources Inventory Committee 1996
148 Resources Inventory Committee 1996
149 MacKenzie 2003
150 Resources Inventory Committee 1996

Plant community: A unit of vegetation with relatively uniform species composition. Plant communities also tend to have characteristic environmental features such as soil type, topographic position, and climate.

Polygon: Delineations that represent a discrete area on a map, bounded by a line. Polygons typically delineate uniform ecosystems but in complex lanscapes may include up to three ecosystem types. On an ecosystem map, polygons depicting ecosystem units represent areas from less than one hectare to tens of hectares depending on the uniformity or complexity of an area.

Profit à prendre: To grant an interest to someone to enter the land and remove something, such as vegetation or soil. This was used in earlier times to provide the rights to someone other than the land owner to remove hay or harvest trees on a property. The taking (profit) distinguishes this right from an easement, which is a right of use over the property of another.

Red-listed: Those indigenous species, subspecies or ecological communities considered provincially rare.

Regosols: Poor or weakly developed soils characteristic of recently deposited materials.

Riparian: Terrestrial areas adjacent to the banks of a stream or any other water body that are influenced by that stream or water body.

Runoff: The part of precipitation and snowmelt that reaches streams, rivers, lakes, or other water bodies by flowing over or through the ground. Surface runoff flows away without penetrating the soils. Groundwater runoff enters water bodies by seeping through soils.

Senescence: Refers to the biological processes of a living organism approaching an advanced age (i.e., the combination of processes of deterioration which follow the period of development of an organism).

Seral species: Plant species of early, middle, and late successional plant communities.

Screening: A method of visually shielding or obscuring an abutting or nearby structure from another by fencing, walls, berms, or densely planted vegetation. Screens are typically vertical objects providing visual separation.

Selection logging: Harvesting of trees selectively where only certain trees are cut and others are left standing.

Sensitive ecosystem: Those remaining natural terrestrial ecosystems which are considered fragile or rare in the SEI study area: wetlands, riparian, old forest, grassland, broadleaf woodland, coniferous woodland, sagebrush steppe, antelope-brush steppe, alpine and sparsely vegetated ecosystems.

Seral: The successional stage of plant communities that follow one another. *See also* **succession**.

Slope stability: Pertains to the susceptibility of slopes to landslides or the rupture and collapse or flow of surficial materials, soil or bedrock.

Soil texture: The relative proportion of sand, silt and clay in the fine fraction (particles <2 mm in size) in the soil. Fine-textured soils are dominated by clay or silt, medium-textured soils have a mixture of sand, silt, and clay, and coarse-textured soils are dominated by sand.

Special Concern: A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Stand-replacing fire: A high severity fire that kills all or nearly all of the overstory trees.

Succession: A series of dynamic changes in ecosystem structure, function, and species composition over time as a result of which one group of organism succeeds another through stages leading to a climax stage. Primary succession occurs when organisms colonise a previously sterile area. Secondary succession occurs on sites that have been previously disturbed (for example, after a fire) in some manner or the natural replacement of a seral ecosystem with a later seral or climax ecosystem.

Suitability: The ability of a habitat in its current natural successional stage to support the life requisites of an organism.

Surface fire: Fires that burn primarily through the understory or grass and herbaceous vegetation in an ecosystem and do not burn in the overstory.

Surficial material[151]**:** Non-rock sediments; usually classified according to how they were deposited (fluvial – deposited by moving water; colluvium – deposited by gravity; lacustrine – deposited by lakes).

Talus[152]**:** Angular rock fragments accumulated at the foot of a steep rock slope and being the product of successive rock falls.

Terrace[153]**:** A step-like landform where each step-like form consists of a flat surface (tread) and a steep slope (scarp) below.

Terrain mapping[154]**:** Mapping that shows surficial materials, soil texture, surface expression, present day geological processes and other features. See also **surficial material**.

Terrestrial ecosystem mapping: The stratification of a landscape into map units according to a combination of ecological features, primarily climate, physiography, surficial material, bedrock geology, soil, vegetation, and disturbance. In the province of British Columbia, Terrestrial Ecosystem Mapping is guided by the Standard for Terrestrial Ecosystem Mapping[155].

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151 Resources Inventory Committee 1996
152 Resources Inventory Committee 1996
153 Resources Inventory Committee 1996
154 Resources Inventory Committee 1996
155 Resources Inventory Committee 1998

Threatened: A wildlife species or ecological community that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Understory: In a forest or woodland, the plants growing beneath the canopy of other plants (trees).

Ungulates: Hoofed mammals, such as deer and sheep.

Windthrow: Tree or trees felled or broken off by the wind. Also known as blowdown

Weed: A plant growing where it is unwanted or a plant that has a negative value within a given management system. For this SEI, a weed is defined as a non-native plant that lacks the natural enemies necessary to restrict its distribution, but the term invasive alien plant is used to avoid confusion with other definitions of weeds. *See also* **noxious weed** and **invasive alien plant**.

Wildlife: Animals, such as invertebrates, amphibians, reptiles, birds, and mammals.

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APPENDIX 1:
Organizations and Resources

Federal Government

Environment Canada
Canadian Wildlife Service
Pacific and Yukon Region
RR 1, 5421 Robertson Road
Delta, B.C. V4K 3N2
Tel: (604) 940-4700
Fax: (604) 946-7022

Department of Fisheries and Oceans
Pacific Region
985 McGill Place
Kamloops, B.C. V2C 6X6
Tel: (250) 851-4950
Fax: (250) 851-4951

Provincial Government

Integrated Land Management Bureau
BC Ministry of Agriculture & Lands
1259 Dalhousie Drive
Kamloops, BC V2C 5Z5
Webpage: http://ilmbwww.gov.bc.ca/

BC Ministry of Agriculture & Lands
162 Oriole Road
Kamloops, B.C. V2C 4N7
Toll free: 1-888-823-3355
Tel: (250) 371-6050
Fax: (250) 828-4631

BC Ministry of Agriculture & Lands
Room 200 – 1690 Powick Road
Kelowna, B.C. V1X 7G5
Toll free: 1-888-332-3352
Tel: (250) 861-7211
Fax: (250) 861-7490

BC Ministry of Environment
102 Industrial Avenue
Penticton, B.C. V2A 7C8
Tel: (250) 490-8200
Fax: (250) 490-2231

BC Ministry of Environment
B.C. Conservation Data Centre
Ecosystems Branch
P.O. Box 9358 Stn. Prov. Govt.
Victoria, B.C. V8W 9M2
Tel: (250) 356-0928
Fax: (250) 387-2733
Email: cdcdata@gov.bc.ca
Webpage: http://www.env.gov.bc.ca/cdc/

BC Ministry of Forests & Range
Okanagan Shuswap Forest District
2501 14th Avenue
Vernon, B.C. V1T 8Z1
Tel: (250) 558-1700
Fax: (250) 549-5485

102 Industrial Avenue
Penticton, B.C. V2A 7C8
Tel: (250) 490-8200
Fax: (250) 490-2231

Regional and Local Governmen:

Regional District of Central Okanagan
1450 K.L.O Road
Kelowna, B.C. V1W 3Z4
Tel: (250) 763-4918
Fax: (250) 763-0606
Email: info@cord.bc.ca
Webpage: http://www.regionaldistrict.com/

Regional District of the North Okanagan
9848 Aberdeen Road
Coldstream, B.C. V1B 2K9
Tel: (250) 550-3700
Fax: (250) 550-3701
Email: info@nord.ca
Webpage: http://www.nord.ca/

Regional District of Okanagan-Similkameen
101 Martin Street
Penticton, B.C. V2A 5J9
Toll Free: 1-877-610-3737
Tel: (250) 492-0237
Email: info@RDOS.bc.ca
Webpage: http://rdos.bc.ca/

City of Kelowna
1435 Water Street
Kelowna, B.C. V1Y 1J4
Tel: (250) 469-8500
Email: ask@kelowna.ca
Webpage: http://www.city.kelowna.bc.ca

City of Penticton
171 Main Street
Penticton, B.C.V2A 5A9
Tel: (250) 490-2400
Fax: (250) 490-2402
Webpage: http://www.penticton.ca/

City of Vernon
3400 – 30th Street
Vernon, B.C. V1T 5E6
Tel: (250) 545-1361
Fax: (250) 545-7876
Webpage: http://www.vernon.ca/

District of Coldstream
9801 Kalamalka Road
Coldstream, B.C. V1B 1L6
Tel: (250) 545-5304
Fax: (250) 545-4733
Email: info@districtofcoldstream.ca
Webpage: http://www.districtofcoldstream.ca

District of Lake Country
10150 Bottom Wood Lake Road
Lake Country, B.C. V4V 2M1
Tel: (250) 766-5650
Fax: (250) 766-0116
Email: csc@lakecountry.bc.ca
Webpage: http://www.lakecountry.bc.ca/

District of Summerland
13211 Henry Avenue, Box 159
Summerland, B.C. V0H 1Z0
Tel: (250) 494-6451
Fax: (250) 494-1415
Email: info@summerland.ca
Webpage: http://www.dist.summerland.bc.ca/

Town of Oliver
35016 – 97th Street
P.O. Box 638
Oliver, B.C. V0H 1T0
Tel: (250) 485-6200
Fax: (250) 498-4466
Webpage: http://www.oliver.ca/

Town of Osoyoos
8707 Main Street
Osoyoos, B.C. V0H 1V0
Tel: (250) 495-6515
Fax: (250) 495-2400
Email: tosoyoos@osoyoos.ca
Webpage: http://www.osoyoos.ca

Non-Government Organizations

Note: this list has been compiled to provide the reader with some sources of further information. This is not intended to be a complete listing of all conservation organizations in or near the SEI study area.

Allan Brooks Nature Centre Society
50 Allan Brooks Way
P.O. Box 20038
Vernon, B.C. V1T 9L4
Tel: (250) 260-4227
Fax: (250) 558-4208
Email: info@abnc.ca
Webpage: www.abnc.ca

Canadian Parks and Wilderness Society – BC Chapter
Local contact: John and Mary Theberge
RR3, Site 25, Comp. 82
Oliver, B.C. V0H 1T0
Tel: (250) 498-5432
Fax: (250) 498-5432
Email: johnmarythe@telus.net
Webpage: www.cpaws.org

Central Okanagan Naturalists Club
P.O. Box 21128
Orchard Park P.O.
Kelowna, B.C. V1Y 9N8
Email: admin@conc.silk.net
Webpage: http://conc.silk.net

Central Okanagan Parks & Wildlife Trust
Contact: Frank Williams
217 – 1889 Springfield Road
Kelowna, B.C. V1Y 5V5
Tel: (250) 861-6160
Email: frankwill@telus.net

Ducks Unlimited Canada
954A Laval Crescent
Kamloops, B.C. V2C 5P5
Tel: (250) 374-8307
Fax: (250) 374-6287
Email: b_arner@ducks.ca
Webpage: www.ducks.ca

BC Nature (Federation of BC Naturalists)
307 – 1367 Broadway
Vancouver, B.C. V6H 4A9
Tel: (604) 737-3057
Fax: (604) 738-7175
Email: fbcn@telus.net
Webpage: www.bcnature.ca
Thompson-Okanagan Region Contact: Jim Bryan (Regional Representative)
Tel: (250) 492-0312

Grasslands Conservation Council of B.C.
954A Laval Crescent
Kamloops, B.C. V2C 5P5
Tel: (250) 374-5787
Fax: (250) 374-6287
Email: gcc@bcgrasslands.org
Webpage: www.bcgrasslands.org

Invasive Plant Council of B.C.
104 – 197 North Second Avenue
Williams Lake, B.C. V2G 1Z5
Tel: (250) 392-1400
Fax: (250) 305-1004
Webpage: www.invasiveplantcouncilbc.ca

Land Trust Alliance of B.C.
204 – 338 Lower Ganges Road
Salt Spring Island, B.C. V8K 2V3
Email: ltabc@saltspring.com
Webpage: www.island.net/~ltabc/

Native Plant Society of B.C.
2012 William Street
Vancouver, B.C. V5L 2X6
Email: information@npsbc.org
Webpage: http://www.npsbc.org/

North Okanagan Naturalists' Club
Box 473
Vernon, B.C. V1T 6M4
Tel: (250) 542-3461
Email: walsted-works@telus.net

North Okanagan Parks & Natural Area Trust
Contact: Geoff Spedding
P.O. Box 265
Vernon, B.C. V1T 6N2
Tel: (250) 545-7673

Okanagan Collaborative Conservation Program
954A Laval Crescent
Kamloops, B.C. V2C 5P5
Tel: (250) 374-5787
Fax: (250) 374-6287
Email: gcc@bcgrasslands.org
Webpage: http://www.bcgrasslands.org/occp.htm

Okanagan Region Wildlife Heritage Fund Society
1326 Scott Crescent
Kelowna, B.C. V1A 2P7
Tel: (250) 769-3952
Fax: (250) 769-0727
Email: jbholdstock@shawcable.com

Okanagan Similkameen Conservation Alliance
233 Main Street, Mezzanine
Penticton, B.C. V2A 5B1
Tel: (250) 492-4422
Toll free: 1-866-699-9453
Fax: (250) 492-5275
Email: judy@osca.org
Webpage: www.osca.org

Okanagan Similkameen Parks Society
P.O. Box 787
Summerland, B.C. V0H 1Z0
Tel: (250) 494-8996
Email: rwhite@img.net

Osoyoos Desert Society
P.O. Box 123
Osoyoos, B.C. V0H 1V0
Tel: (250) 495-2470
Toll free: 1-877-899-0897
Fax: (250) 495-2474
Email: mail@desert.org
Webpage: www.desert.org

South Okanagan Similkameen Conservation Program
102 Industrial Place
Penticton, B.C. V2A 8E1
Tel: 250-490-8225
Webpage: www.soscp.org

The Land Conservancy of British Columbia
5793 Old West Saanich Road
Victoria, B.C. V9E 2H2
Tel: (250) 479-8053
Fax: (250) 744-2251
Email: admin@conservancy.bc.ca
Webpage: www.conservancy.bc.ca

The Living by Water Project
B.C./Yukon Regional Office
P.O. Box 7
Salmon Arm, B.C. V1E 4N2
Tel: (250) 832-7405
Fax: (250) 832-6874
Email: shorelines@jetstream.net
Webpage: www.livingbywater.ca

The Nature Conservancy of Canada
300 – 1205 Broad Street
Victoria, B.C. V8W 2A4
Toll free: 1-888-404-8428
Tel: (250) 479-3191
Fax: (250) 479-0546
Email: bcoffice@natureconservancy.ca
Webpage: www.natureconservancy.ca

The Nature Trust of B.C.
2600 – 1000 Roosevelt Crescent
West Vancouver, B.C. V7P 1M3
Toll free: 1-866-288-7878
Tel: (604) 924-9771
Fax: (604) 924-9772
Email: info@naturetrust.bc.ca
Webpage: www.naturetrust.bc.ca

The Nature Trust of B.C.
South Okanagan Branch Office
RR 2, Site 42, Comp 17
Oliver, B.C. V0H 1T0
Tel: (250) 498-5474
Fax: (250) 498-5475

West Coast Environmental Law Association
1001 – 207 West Hastings Street
Vancouver, B.C. V6B 1H7
Tel: (604) 684-7378
Fax: (604) 684-1312
Email: admin@wcel.org

Wetkit: Tools for working with wetlands in Canada
Webpage: www.wetkit.net
Appendix II: At-risk wildlife species in study area

APPENDIX II:
At-risk wildlife species in the study area

Listed wildlife species known to occur within the study area as listed on BC Species and Ecosystems Explorer (current as of December 2007).

Common Name	Scientific Name	Federal Status	Provincial Status	BC Occurrence Comments	Habitat Comments
INVERTEBRATES					
Mormon Metalmark	*Apodemia mormo*	Endangered	Red	Lower Similkameen	Gravel banks
Immaculate Green Hairstreak	*Callophrys affinis*		Blue	Okanagan Valley west to Douglas Lake Ranch, and Southern Boundary	Grassland and shrub-steppe
Monarch	*Danaus plexippus*	Special Concern	Blue	Southern BC	Riparian
Nevada Skipper	*Hesperia nevada*		Blue	Okanagan, Similkameen, and South Thompson	Coniferous woodland
Viceroy	*Limenitis archippus*		Red	Extirpated	
Lilac-bordered Copper	*Lycaena nivalis*		Blue	Okanagan Valley to Rock Creek	mid to high elevations – closed forest
Sandhill Skipper	*Polites sabuleti*		Red	Okanagan Valley	Short grass & disturbed habitats
Sonora Skipper	*Polites sonora*	Special Concern	Red	Similkameen	Mid elevation grassland or clearings – sagebrush, coniferous woodland
Checkered Skipper	*Pyrgus communis*		Blue	North Okanagan & Kootenays	Short grass & disturbed habitats
Behr's Hairstreak	*Satyrium behrii*	Threatened	Red	South Okanagan	Antelope-brush
California Hairstreak	*Satyrium californica*		Blue	South Okanagan, Southern Boundary, Thompson, and Fraser Canyon (Lillooet to Grand Forks)	Grassland, shrub-steppe, coniferous woodland
Half-moon Hairstreak	*Satyrium semiluna*	Endangered	Red	South Okanagan & lower Similkameen	Sagebrush-steppe
Lance-tipped Darner	*Aeshna constricta*		Red	Dry southern valleys at low elevations; Nicola east to Creston area; most records in Okanagan and most of these south of Kelowna.	Marshes and ponds with rich aquatic vegetation
Emma's Dancer	*Argia emma*		Blue	Main concentrations of records at low to mid elevations in Fraser and Okanagan valleys.	Warm/ cool streams and associated wetlands
Vivid Dancer	*Argia vivida*		Red	Mostly Kootenays, but also also South Okanagan, Similkameen,Pemberton area, and Fraser Canyon.	In Okanagan, streams flowing from cool springs and associated wetlands

Common Name	Scientific Name	Federal Status	Provincial Status	BC Occurrence Comments	Habitat Comments
INVERTEBRATES					
Western Pondhawk	*Erythemis collocata*		Blue	South Coast at low elevations; oxbows at north end of Osoyoos Lake.	Warm ponds
Pronghorn Clubtail	*Gomphus graslinellus*		Blue	Southern Interior valleys at low elevations; Okanagan–Shuswap; Christina Creek; Wasa Lake. Most records from South Okanagan.	Shores of warm lakes with sandy bottoms
Twelve-spotted Skimmer	*Libellula pulchella*		Blue	Southern Interior valleys at low elevations. Vast majority of records from Okanagan, but other records in Boundary, and Kootenay regions.	Warm marshy lakeshores and ponds
Western River Cruiser	*Macromia magnifica*		Blue	Main concentrations of records at low elevations in Okanagan – Shuswap; Christina Lake and Creek. Population in upper Fraser valley (Cultus Lake, Kawkawa Lake).	Warm streams and along lakeshores
Blue Dasher	*Pachydiplax longipennis*		Blue	South Coast at low elevations; oxbows at north end of Osoyoos Lake.	Warm ponds
Olive Clubtail	*Stylurus olivaceus*		Red	Low elevations in Okanagan – Thompson River valleys; Christina Creek.	Warm (mostly large) streams
Autumn Meadowhawk	*Sympetrum vicinum*		Blue	Mostly south coast but some records from South Okanagan and Creston Valley.	Marshes and marshy lakeshores
California Floater	*Anodonta californiensis*		Blue	Kalamalka, Okanagan, Skaha and Cultus Lakes	Lakes
Winged Floater	*Anodonta nuttalliana*		Blue		Lakes
Attenuate Fossaria	*Fossaria truncatula*		Blue		Lakes
Rocky Mtn. Ridged Mussel	*Gonidea angulata*		Red	South Okanagan lakes	Lakes
Umbilicate Sprite	*Promenetus umbilicatellus*		Blue		Lakes
Abbreviate Pondsnail	*Stagnicola apicina*		Blue	Okanagan and Skaha Lakes	Lakes
Black Gloss	*Zonitoides nitidus*		Blue		Lakes
FISH					
Chiselmouth	*Acrocheilus alutaceus*		Blue	Mostly Similkameen, Okanagan and Kettle	Lakes and rivers

Common Name	Scientific Name	Federal Status	Provincial Status	BC Occurrence Comments	Habitat Comments
FISH					
Umatilla Dace	*Rhinichthys umatilla*	Special Concern	Red	Similkameen and Kettle Rivers and lower Columbia drainage	Rivers
Mountain Sucker	*Catostomus platyrhynchus*		Blue	Mostly Similkameen	Rivers
Chinook Salmon (Okanagan)	*Oncorhynchus tshawytscha*	Threatened	-	Only Okanagan R. population listed	Rivers
Columbia Sculpin	*Cottus hubbsi*	Special Concern	Blue		Lakes, rivers, and streams
AMPHIBIANS					
Northern Leopard Frog	*Rana pipiens*	Endangered	Red	Historically known from Okanagan; now only one location in Kootenays	Lakes and wetlands
Western Toad	*Bufo boreas*	Special Concern	-		Lakes and wetlands
Great Basin Spadefoot	*Spea intermontana*	Threatened	Blue		Wetlands, grassland and shrub-steppe
Tiger Salamander	*Ambystoma tigrinum*	Endangered	Red	South Okanagan and southern Boundary	Lakes and wetlands, grassland and shrub-steppe
REPTILES					
Painted Turtle	*Chrysemys picta*	Special Concern	Blue		Lakes and permanent wetlands
Pigmy Short-horned Lizard	*Phrynosoma douglasii*	Extirpated	Red	South Okanagan, historically	Grassland and shrub-steppe
Western Skink	*Eumeces skiltonianus*	Special Concern	Blue		Rocky areas in most low to mid elevation eco-systems; shallow-soiled grassland or sagebrush
Rubber Boa	*Charina bottae*	Special Concern	-		Coniferous woodland, rock for denning
Racer	*Coluber constrictor*	Special Concern	Blue		Rocky habitats, grassland and shrub-steppe
Night Snake	*Hypsiglena torquata*	Endangered	Red	South Okanagan	Rocky habitats, grassland and shrub-steppe
Gopher Snake	*Pituophis catenifer deserticola*	Threatened	Blue		Rocky habitats, grassland, shrub-steppe, and coniferous woodland.
Western Rattlesnake	*Crotalus oreganus*	Threatened	Blue		Rocky habitats, riparian, wetland, shrub-steppe, and coniferous woodland

Common Name	Scientific Name	Federal Status	Provincial Status	BC Occurrence Comments	Habitat Comments
BIRDS					
Western Grebe	*Aechmophorus occidentalis*		Red		Wetlands
Great Blue Heron	*Ardea herodias herodias*		Blue		Wetlands and riparian
American Bittern	*Botaurus lentiginosus*		Blue		Wetlands
Swainson's Hawk	*Buteo swainsoni*		Red		Grassland, coniferous woodland
Ferruginous Hawk	*Buteo regalis*	Special Concern	-		Forage in grassland and shrub-steppe; nesting habitat variable
Prairie Falcon	*Falco mexicanus*		Red		Cliffs for nesting; grassland and shrub-steppe for foraging
Peregrine Falcon	*Falco peregrinus anatum*	Special Concern	Red		Cliffs for nesting; open areas, especially lakes and wetlands for foraging
Greater Sage-Grouse	*Centrocercus urophasianus*	Extirpated	Red	Historically occurred in South Okanagan and possibly lower Similkameen	Sagebrush, historically
Sharp-tailed Grouse	*Tympanuchus phasianellus columbianus*		Blue		Grassland
Sandhill Crane	*Grus canadensis*		Blue		Wetlands
American Avocet	*Recurvirostra americana*		Red		Wetlands
Long-billed Curlew	*Numenius americanus*	Special Concern	Blue		Short-grass grasslands
California Gull	*Larus californicus*		Blue	Breeding known from four locations, including Okanagan Lake	Nests on islands; forages in open habitats
Barn Owl	*Tyto alba*	Special Concern	Blue	South Coast and Okanagan Valley	Agricultural fields
Short-eared Owl	*Asio flammeus*	Special Concern	Blue		Short-grass grasslands
Burrowing Owl	*Athene cunicularia*	Endangered	Red	Reintroduced in Thompson and (formerly) South Okanagan	Grassland (not shrub-steppe)
Western Screech-Owl	*Megascops kennicottii macfarlanei*	Endangered	Red		Riparian, especially mature or old cottonwood
Flammulated Owl	*Otus flammeolus*	Special Concern	Blue		Open Douglas-fir forest; mixed age stands

Common Name	Scientific Name	Federal Status	Provincial Status	BC Occurrence Comments	Habitat Comments
BIRDS					
Common Nighthawk	*Chordeiles minor*	Threatened	-		Open and semi-open areas
Lewis' Woodpecker	*Melanerpes lewis*	Special Concern	Red		Grassland and shrub-steppe with scattered trees and snag:
White-headed Woodpecker	*Picoides albolarvatus*	Endangered	Red	South Okanagan	Mature and old coniferous woodland (Ponderosa pine)
Williamson's Sapsucker	*Sphyrapicus thyroideus thyroideus*	Endangered	Red	Southern Interior	Mature and old forest (larch)
Gray Flycatcher	*Empidonax wrightii*		Blue	South Okanagan	Young ponderosa pine forest
Barn Swallow	*Hirundo rustica*		Blue		Buildings; insect rich areas
Canyon Wren	*Catherpes mexicanus*		Blue	Mostly South Okanagan	Rocky habitats, especially talus
Sage Thrasher	*Oreoscoptes montanus*	Endangered	Red	South Okanagan	Sagebrush-steppe
Yellow-breasted Chat	*Icteria virens*	Endangered	Red	Mostly South Okanagan	Riparian, especially dense rose thickets
Grasshopper Sparrow	*Ammodramus savannarum*		Red	Mostly Okanagan	Grassland
Lark Sparrow	*Chondestes grammacus*			Mostly South Okanagan	Shrub-steppe, especially antelope-brush (not grassland)
Brewer's Sparrow	*Spizella breweri breweri*		Red	South Okanagan	Sagebrush-steppe
Bobolink	*Dolichonyx oryzivorus*		Blue		Old hayfields and moist meadows or pastures (not wetlands)
MAMMALS					
Merriam's Shrew	*Sorex merriami*		Red	Known from one location in SOK, near Kilpoola Lake	Sagebrush; possibly grassland and antelope-brush
Preble's Shrew	*Sorex preblei*		Red	Known from three locations in SOK, Kobau and Vaseux	Grassland and antelope-brush; possibly sagebrush-steppe
Pallid Bat	*Antrozous pallidus*	Threatened	Red	South Okanagan	Cliffs and rock outcrops for roosting; grassland and shrub-steppe for foraging
Townsend's Big-eared Bat	*Corynorhinus townsendii*		Blue		Cliffs, rock outcrops and anthropogenic features for roosting; variable for foraging, especially riparian

Common Name	Scientific Name	Federal Status	Provincial Status	BC Occurrence Comments	Habitat Comments
MAMMALS					
Spotted Bat	*Euderma maculatum*	Special Concern	Blue		Cliffs for roosting; variable habitats for foraging
Western Red Bat	*Lasiurus blossevillii*		unknown	One historic record in Skagit Valley, and echolocation calls calls from South Okanagan. If extant, one of BC's rarest bats	Riparian areas for roosts and foraging
Western Small-footed Myotis	*Myotis ciliolabrum*		Blue		Rocky areas for roosting; wetlands, grassland, shrub-steppe for foraging
Fringed Myotis	*Myotis thysanodes*		Blue		Rocky areas for roosting; wetlands, grassland, shrub-steppe for foraging
Wolverine	*Gulo gulo luscus*	Special Concern	Blue	Very low numbers	Variable; prefers alpine and mature or old forest at high elevations
Fisher	*Martes pennanti*		Blue	Considered extirpated in Okanagan, but may still occur in very low numbers	Mature and old coniferous and riparian forest at mid-elevations
Badger	*Taxidea taxus*	Endangered	Red		Grassland, shrub-steppe, and other open areas
Grizzly Bear	*Ursus arctos*	Special Concern	Blue	Okanagan population considered extirpated, but occurs in very low numbers	Highly varied; not likely in valley bottom
California Bighorn Sheep	*Ovis canadensis*		Blue	Okanagan supports largest herd of 'California' form	Rugged terrain for security, including cliffs for lambing; grassland and shrub-steppe for foraging; closed forest for winter cover
Great Basin Pocket Mouse	*Perognathus parvus*		Red	Thompson-Okanagan	Grassland and shrub-steppe
Western Harvest Mouse	*Reithrodontomys megalotis*	Special Concern	Blue	Okanagan	Grassland and shrub-steppe, edges and agricultural areas
White-tailed Jackrabbit	*Lepus townsendii*		Red	South Okanagan and lower Similkameen – probably extirpated	Grassland and shrub-steppe
Nuttall's Cottontail	*Sylvilagus nuttallii*	Special Concern	Blue	Okanagan and lower Similkameen	Rocky areas in grassland and shrub-steppe

APPENDIX III:
At-risk plant species in the study area

Scientific Name	Common name	COSEWIC Status	Provincial Status
Agastache urticifolia	Nettle-leaved Giant-hyssop		Blue
Allium validum	Swamp Onion		Red
Ammannia robusta	Scarlet Ammannia	E (MAY 2001)	Red
Apocynum x floribundum	Western Dogbane		Blue
Aster frondosus	Short-rayed Aster	E (APR 2006)	Red
Astragalus filipes	Threadstalk Milk-vetch		Blue
Astragalus sclerocarpus	The Dalles Milk-vetch		Red
Atriplex argentea ssp. *argentea*	Silvery Orache		Red
Azolla mexicana	Mexican Mosquito Fern	T (MAY 2000)	Red
Bolboschoenus fluviatilis	River Bulrush		Red
Botrychium paradoxum	Two-spiked Moonwort		Red
Brickellia oblongifolia ssp. *oblongifolia*	Narrow-leaved Brickellia		Red
Calochortus lyallii	Lyall's Mariposa Lily	T (MAY 2001)	Red
Camissonia andina	Andean Evening-primrose		Red
Camissonia breviflora	Short-flowered Evening-primrose		Red
Carex comosa	Bearded Sedge		Red
Carex sychnocephala	Many-headed Sedge		Blue
Carex vulpinoidea	Fox Sedge		Blue
Carex xerantica	Dry-land Sedge		Red
Castilleja minor ssp. *minor*	Annual Paintbrush		Red
Centaurium exaltatum	Western Centaury		Red
Chamaesyce serpyllifolia ssp. *serpyllifolia*	Thyme-leaved Spurge		Blue
Coreopsis tinctoria var. atkinsoniana	Atkinson's Coreopsis		Red
Crepis atribarba ssp. *atribarba*	Slender Hawksbeard		Red
Cryptantha ambigua	Obscure Cryptantha		Blue
Cryptantha celosioides	Cockscomb Cryptantha		Red
Cryptantha watsonii	Watson's Cryptantha		Red

Scientific Name	Common name	COSEWIC Status	Provincial Status
Cuscuta campestris	Field Dodder		Blue
Cyperus erythrorhizos	Red-rooted Cyperus		Red
Cyperus squarrosus	Awned Cyperus		Blue
Dryopteris cristata	Crested Wood Fern		Blue
Elatine rubella	Three-flowered Waterwort		Blue
Eleocharis atropurpurea	Purple Spike-rush	E (APR 2007)	Red
Eleocharis rostellata	Beaked Spike-rush		Blue
Elodea nuttallii	Nuttall's Waterweed		Blue
Entosthodon rubiginosus	Rusty Cord-moss	E (NOV 2004)	Red
Epipactis gigantea	Giant Helleborine	SC (MAY 1998)	Blue
Eragrostis pectinacea	Tufted Lovegrass		Red
Erigeron poliospermus var. *poliospermus*	Cushion Fleabane		Blue
Eriogonum strictum var. *proliferum*	Strict Buckwheat		Red
Gaura coccinea	Scarlet Gaura		Red
Gayophytum humile	Dwarf Groundsmoke		Blue
Gayophytum ramosissimum	Hairstem Groundsmoke		Red
Gentiana affinis	Prairie Gentian		Blue
Gilia sinuata	Shy Gilia		Red
Halimolobos whitedii	Whited's Halimolobos		Red
Hutchinsia procumbens	Hutchinsia		Red
Impatiens aurella	Orange Touch-me-not		Blue
Lappula occidentalis var. *cupulata*	Western Stickseed		Red
Lepidium densiflorum var. *pubicarpum*	Prairie Pepper-grass		Red
Linanthus septentrionalis	Northern Linanthus		Blue
Lindernia dubia var. *anagallidea*	False-pimpernel		Blue
Lipocarpha micrantha	Small-flowered Lipocarpha	E (NOV 2002)	Red
Marsilea vestita	Hairy Water-clover		Red
Microbryum vlassovii	Nugget Moss	E (NOV 2006)	Red
Myosurus apetalus var. borealis	Bristly Mousetail		Red
Orobanche corymbosa ssp. *mutabilis*	Flat-topped Broomrape		Red

Scientific Name	Common name	COSEWIC Status	Provincial Status
Orthocarpus barbatus	Grand Coulee Owl-clover	E (MAY 2005)	Red
Pectocarya penicillata	Winged Combseed		Red
Phlox speciosa ssp. *occidentalis*	Showy Phlox	T (NOV 2004)	Red
Physaria didymocarpa var. didymocarpa	Common Twinpod		Blue
Polemonium occidentale ssp. *occidentale*	Western Jacob's-ladder		Blue
Polygonum engelmannii	Engelmann's Knotweed		Blue
Polygonum punctatum	Dotted Smartweed		Blue
Polystichum lemmonii	Lemmon's Holly Fern	T (MAY 2003)	Red
Potentilla paradoxa	Bushy Cinquefoil		Red
Pterygoneurum kozlovii	Alkaline Wing-nerved Moss	T (NOV 2004)	Red
Pyrrocoma carthamoides var. carthamoides	Columbian Goldenweed		Red
Rotala ramosior	Toothcup Meadow-foam	E (MAY 2000)	Red
Salix amygdaloides	Peach-leaf Willow		Red
Salix tweedyi	Tweedy's Willow		Blue
Sphaeralcea coccinea	Scarlet Globe-mallow		Red
Sphaeralcea munroana	Munroe's Globe-mallow		Red
Sporobolus airoides	Hairgrass Dropseed		Red
Talinum sediforme	Okanogan Fameflower	NAR (MAY 1990)	Blue
Thelypodium laciniatum var. laciniatum	Thick-leaved Thelypody		Blue
Verbena hastata var. scabra	Blue Vervain		Red

APPENDIX IV: Incorporating SEI Information into Environmental Impact Assessments

Environmental Impact Assessments (EIAs) may by necessary where rezoning, subdivision, or other land development occurs within a Development Permit Area or areas where development approval information is required.

EIAs should be conducted early in the development process to allow for flexibility in creating a development proposal that conserves sensitive ecosystems and wildlife habitat, while meeting the proponent's needs. The process may be iterative — after getting information about the development layout, the consultant will then provide specific suggestions on how to alter the layout to promote the protection of environmental values. Depending on the zoning of the site, the proponent should contact the Regional District or Municipality about the possibility of cluster development and density bonuses.

Sensitive ecosystem mapping can provide information about the environmental impacts of housing and other development by highlighting sensitive ecosystems in the area. The following procedure provides a guide to incorporating SEI information into EIAs.

1. The EIA must be prepared by a registered professional biologist together with other professionals[156] of different expertise, as the project warrants. Hydrologists and hydrogeologists should be consulted where wetlands, riparian areas, and broadleaf woodlands exist within the development area to ensure that proper hydrological function is maintained within these ecosystems. A professional geoscientist should be consulted where there is erosion potential or where there are slope stability hazards. The team of consultants must have an understanding of wildlife biology, especially for species at risk, geomorphology, environmental assessment, and development planning in British Columbia. Specific expertise in the Okanagan Valley wildlife species, wildlife habitat, and ecosystems is highly preferred.
2. Use the digital Sensitive Ecosystem and Wildlife Habitat mapping files to generate a sensitive ecosystems map and wildlife habitat maps for the proposed development area plus a surrounding area that is at least equal in width to the development area. Use the soil erosion and slope stability maps to determine if any risks exist in the development area.
3. A field assessment should be conducted:
   a. For those SEI polygons where field data has not been collected. Conduct ground-truthing, including an assessment of the quality and condition of the ecosystems. For complex polygons, map sensitive ecosystems at a larger scale than used in the original SEI to show specific locations;

These are guidelines for people planning land developments according to local government regulations. This information can be helpful in developing an Environmental Impact Assessment under provincial or federal guidelines, which are specified under the following acts: Canadian Environmental Assessment Act (Available at: http://laws.justice.gc.ca/en/C-15.2/) BC Environment Assessment Act (Available at: http://www.qp.gov.bc.ca/statreg/stat/E/02043_01.htm)

156 A collaborative team of consultants often provides the best combination of experience and expertise in the broad range of fields necessary to complete an effective Environmental Impact Assessment.

b. Where wildlife habitat maps exist and indicate potential significant wildlife habitat, verify the presence of wildlife or their habitats by completing a detailed species inventory. Each sensitive ecosystem chapter has a list of the known at-risk wildlife that could occur in that ecosystem in the Okanagan. Species in these lists may occur in other ecosystems as well. The current status of all potentially occurring species needs to be checked, particularly for any newly listed or up-listed species. All of these species should be addressed in the assessment. Inventories should take place during the time(s) of year when wildlife species of interest are expected to be present. It will be difficult to verify the presence of some species. It may be necessary to retain the services of species experts, or assume the presence of these species based on habitat suitability and forgo expensive inventory efforts. A lack of observations by general biologists does not mean the species is not present, just that it was not observed.; and

c. Verify any potential soil erosion (ratings of Moderate, High, or Very High) or slope stability (Class III and up) problems in the field.

4. Revise the sensitive ecosystems and wildlife habitat mapping to reflect the field verification work. Justification for revisions must be clearly described in a report.
5. Identify long and short-term effects the proposed development is likely to have on sensitive ecosystems and wildlife habitat (direct, indirect and cumulative impacts).
6. Generate a site plan that incorporates the management recommendations for each sensitive ecosystem category that optimizes conservation of sensitive ecosystems and wildlife habitat, maintains connectivity, buffers and corridors, and avoids erosion potential or slope stability risks. The plan should seek to maintain connectivity between sensitive ecosystems and important wildlife habitats in adjacent areas.
7. Determine the construction schedule and type of equipment that will minimize or avoid adverse environmental effects.
8. Identify opportunities to restore or enhance sensitive ecosystems and wildlife habitat.
9. Identify how the proposed development will affect sensitive ecosystems and wildlife habitat, and provide recommendations to reduce negative impacts and mitigate unavoidable impacts (e.g. restoration or enhancement).

APPENDIX V:
SEI Data Mapping Standards and Contacts

Obtaining SEI Data

Spatial (GIS files) and non-spatial data (field data, reports, legends and maps) for the SEI and Terrestrial Ecosystem Mapping (TEM) components of each project within the study area, are available for download from the Ministry of Environment's **Ecological Reports Catalogue (EcoCat)**:
http://www.env.gov.bc.ca/ecocat/

SEI Mapping Standard

A provincial standard for mapping sensitive ecosystems has been developed and is available from the Resource Inventory Standards Committee website http://ilmbwww.gov.bc.ca/risc/pubs/teecolo/habitat/assets/standards_for_mapping_ear_version1.pdf. This document outlines sensitive ecosystem unit characterization, map symbols, field sampling and mapping procedures, legends, and reporting. It outlines how to model sensitive ecosystems from TEM, describes core data attributes as well as other attributes that are recommended to support conservation planning. The report also explains the methods for mapping and evaluating ecological integrity of CDC element occurrences from sensitive ecosystems.

SEI Website

General information on Sensitive Ecosystems Inventory can be obtained at the SEI website http://www.env.gov.bc.ca/sei/ or by contacting the following:

SEI Contacts

Ministry of Environment
Conservation Data Centre
PO Box 9358 Stn Prov. Govt. Victoria, B.C. V8W 9M2
Tel: (250) 356-0928
Fax: (250) 387-2733
Email: cdcdata@gov.bc.ca
Website: http://srmwww.gov.bc.ca/cdc/

Environment Canada
Canadian Wildlife Service
Pacific and Yukon Region
RR 1, 5421 Robertson Road, Delta, B.C. V4K 3N2
Tel: (604) 940-4700
Fax: (604) 946-7022
Website: http://www.pyr.ec.gc.ca/EN/index.shtml

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